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Plate Bending and Straightening Machinery.

On this and the following page we give illustrations of some heavy machines recently constructed by The Hilles & Jones Co., of Wilmington, Del , the one on this page being for the straightening of heavy plates. In this machine seven rolls of hammered steel are arranged in two horizontal rows, the four larger rolls being above. These can be moved up or down together by means of the large hand-wheel, thus keeping them at the same relative height, and always in line with the lower rolls. In addition to this, there is a separate vertical adjustment for the two outside upper rolls by means of the smaller hand-wheel, this adjustment being necessary to make the plate come from the machine perfectly straight. The lower rolls are driven by means of the pair of vertical reversing engines shown mounted on the bed plate, which extends under the entire machine, keeping all bearings of engines and rolls in alignment. The lower rolls are connected together at the ends farthest from the engines by steel pinions.

The advantage of having such a machine driven by independent engines arises from the fact that it must frequently be placed where long lines of shafting would be necessary to reach it. The engines also make it possible to use the machine where line shafting could not well be erected, and at any time independent of other power.

The machine shown on page 2 was specially gotten up for the quick and convenient handling of boiler plate. The whole machine is substantially constructed, with heavy gearing, steel pinions for driving, and a hinged back housing and counterbalanced top roll, which allow the quick removal of sheets bent to a circle. The rolls are all of best hammered wrought-iron, the extension of the top roll being solid with the body. The main driving for the bottom rolls is done by a pair of friction clutch pulleys. In addition to this arrangement there is another pair of friction clutch pulleys, which drive separately and work gears for raising and lowering the top roll. It will thus be seen that the man in charge of the machine, by means of two levers, has control of all motions of the machine. This saves at least one man in the handling of heavy plates, and a good deal of time in addition. There is a substantial bedplate under the entire machine, and the proportion of gearing, diameters of bearings, etc., have been carefully considered. Rolls of this design are made in any length from 10′ to 20′, for various purposes.

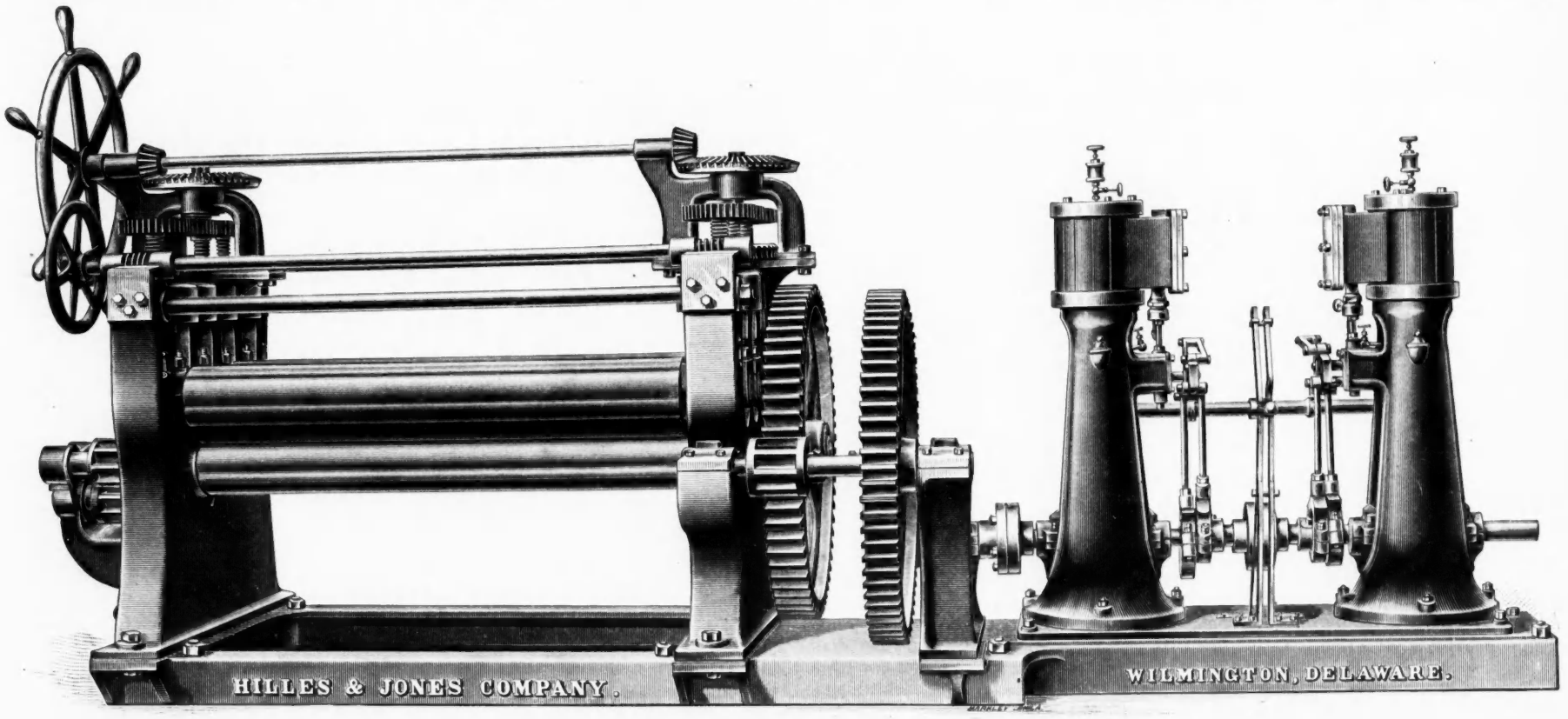


PLATE STRAIGHTENING MACHINE.

Vertical Belts.

A considerable proportion of the questions addressed to our "Question and Answer" column relate to belts and the power they may be expected to transmit. For ordinary working conditions, the proportions for belts and pulleys are pretty well understood, notwithstanding the glaring contradiction found among the authorities on the subject.

There is, we believe, a general impression among mechanics that a vertical belt cannot, under ordinary working conditions, be depended upon to transmit quite as much power as would be transmitted by the same belt running horizontally over the same pulleys. Of course no one doubts that the transmission would be the same, if the pressure of the belt upon the pulleys were the same; but in the case of a verical belt its weight always tends to reduce its pressure upon, and consequently its adhesion to, the lower pulley, and as the belt becomes slack by stretching in use, this evil is increased. If this is prevented by the use of a tightener running on the belt, the power required to drive it, and the wear on the belt, are to be considered, so that it would seem to be best to allow some extra width for a vertical belt in most cases.

While this is about the way the average mechanic looks at the matter, there has been no statement, so far as we are aware, how much allowance should be made. In a recent answer to a correspondent we allowed about 20 per cent. This would probably be too much in some cases, and might have been rather more than sufficient in the case given, but it was founded simply on our observation of the practical working of such belts. In order to bring out, if possible, something authoritative on this subject, we addressed letters of inquiry to two firms, both of whom have had large experience with belts, pulleys and shafting, asking for a statement of their practice.

Mr C. C. Briggs answers for Jones & Laughlin, of Pittsburgh, as follows:

We are in receipt of yours of the 19th inst., and would say that a vertical belt should transmit precisely the same amount of horse-power as a belt running horizontally, or at an angle, provided you have proper means of keeping the belt tight. Wherever it is possible, however, all vertical belts should be avoided, because it is absolutely necessary to keep them tight, and in applying tighteners the necessary judgment and caution is not always exercised. Much harm is done to shafting by belts being *over*-tight, and consequently bringing an undue load upon the bearings, causing heating. Tighteners of all kinds are objectionable, besides being expensive, and wherever it is possible to apply belts at an angle, it should be done.

Wm. Sellers & Co's. reply is as follows:

Your letter of the 19th inst., asking for publication in the AMERICAN MACHINIST, our rule for the horse-power of belts when vertical or inclined, as compared with the same when horizontal, is at hand.

It is not easy to answer such a question categorically, but you will see by reference to our published experiments, as presented by Wilfred Lewis, in Vol. VII., Trans. A. S. M. E., that the question is one to which we have given some attention. The pulling power of a belt depends in general upon so many conditions, that its determination for any particular case is always a matter of some uncertainty, and after all is said and done, we think it must be admitted that the rules laid down by Mr. A. F. Nagle, in Vol. II., Trans. A. S. M. E., are about as near the truth for average working conditions as it is possible to conjecture. He assumes .40 for the coefficient of friction (a value well within the limits of our experience) and allows 275 pounds per square inch for the working strength of laced belts, and 400 pounds per square inch for the working strength of belts without lacing, cemented and riveted, and gives tables for the horse-power developed at different speeds. We think these tables may be taken to indicate the proper working capacity of any belt, whether horizontal, vertical or inclined, and when the values there given are exceeded, as may frequently be the case, the proper working strength of the material is exceeded also, causing undue stretching or injury to the belt. It is tacitly assumed by Mr. Nagle, that the tension on the slack side of the belt is just enough and no more than sufficient to prevent slip; but it need hardly be said that this assumption is seldom realized in practice. When first put on, belts are always made tighter than they need to be for the work required, in order to allow for the stretching which is sure to follow. They are then run until they become too loose for efficient service, and the process of over-straining and stretching is repeated. When

vertical, this stretching of the belt acts directly to loosen it, and the necessity for tightening occurs more frequently than it does on horizontal belts where the weight between pulleys maintains more or less tension in the slack side. For this reason, a long horizontal belt can hardly be made to slip without working it to destruction, while the driving power of a vertical belt depends directly upon its initial tension, and this must be carefully looked after to obtain the best results. The position in which a belt may run, therefore, does not affect the size required for any given duty, but it does affect very seriously the amount of care and attention required to keep it in efficient service, and for this reason alone we think it advisable to give vertical belts about 10 per cent. more section than Nagle's rule requires. It should be understood, however, that we do this only for the purpose of reducing the cost of maintenance, and that our practice in this respect may be modified by further experience. A horizontal belt is preferable to a vertical on many accounts. It takes care of itself in stretching, requires less initial tension for a given duty, and runs more freely under light loads, with less risk of slipping under heavy ones. Previous to our experiments it was generally supposed or assumed that the sum of the tensions was constant; that is, that one side lost what the other gained in the transmission of power (and this idea still seems to linger in the minds of some people who ought to know better, as evidenced at the last meeting of the A. S. M. E.), but, so far from this being the case, we have shown conclusively that in all cases the sum of the tensions increases with the power transmitted. For vertical belts, the maximum increase in tensions, as shown by our experiments, was about one-third of the initial tensions, while for horizontal belts it was frequently 100 per cent., and sometimes 200 per cent. Therefore, in fixing the initial tension for a horizontal or vertical belt, a certain amount of gain in tension can be fairly allowed for.

In conclusion, we can say that, while there is a vast difference in the capabilities of horizontal and vertical belts at the same initial tension, there is no difference in performance when both are working to the best advantage, and that the difficulty of maintaining a vertical belt at the proper tension seems to call for an increase in section over a horizontal belt for the same duty.

[The experiments made by Wm. Sellers & Co. on belt transmission were carried on in a very thorough manner, were quite extensive, and there was much ingenuity in devising means of eliminating errors, and arriving at correct conclusions. The results of the experiments, as presented to the American Society of Mechanical Engineers by Mr. Lewis, form a paper of great interest to those who have to do with belts. The experiments with vertical belts, however, were designed to show only the increase of the sum of the tensions, the results, as compared with horizontal belts, being given in their letter above, which shows that the increase of the sum of the tension when the belt is working may be considerably greater in the case of horizontal than with vertical belts.—Ed.]

Locomotive Repairing.

By M. Barker.

(Extracts from a Paper read before the Engineering Students' Club, Newcastle-on-Tyne.)

Nothing comes up to good strong brass axle-boxes for economy in wear. The author has seen boxes examined and replaced without any repairs after fifteen or sixteen years' service, and this is comparing with the average life of ten years. The facility of repairing is another advantage; should the journal of the box be worn too large, short ½″ holes are drilled all over the side and bearing parts, and a layer of white metal run in. In fact, the box is restored to its original size with white metal; the wear between the guides is made up by means of cast-iron liners riveted onto the boxes with ½″ copper studs, and the box then planed to suit the horn cheeks. The cheeks themselves are generally chipped, filed and faced square with each other, a long straight-edge being tried across the two frames. More recently a machine driven by an endless rope has been devised, carrying four tools at once. The saving in time is very considerable, and the quality of the work is unequaled by hand, though perhaps the machines are more wasteful in material. In designing horn blocks, care should be taken to leave parts which are unexposed to wear at least one-eighth of an inch clear; if they are not so, at each repairing the horn stays will require adjusting, or else the whole strain will be borne by the frame plates. Cast steel blocks answer very well, and run for a long while without needing any repairs, though the hardness of the material, especially with the skin unbroken, renders it next to impossible to use hand tools when such are needed. The form best adapted for engines of all classes is the one at present in use on the North-Eastern and several other railways. Both cheeks are cast in one—that is, they are joined across the top by an angular sectional piece. They fit all round the recess in the frame, and are secured by turned bolts driven into reamed holes. The back cheek consists of a cast-iron wedge bolted to the block through a slot, and adjusted in the usual way by means of a stud and nuts on each side of the horn stay. The attachment of the stud, or rather bolt, is ingenious. A circular hole about 1¼″ diameter and 2″ deep is cast in the back of the wedge about 1½″ from the bottom. The side of the hole next to the bottom of the wedge is cut away 1″ wide. The bolt, 1″ diameter, has a circular head 1¼″ diameter attached the same thickness as the bolt, but to its circumference instead of to its face. Through the center of this head a ¼″ hole is drilled. The bolt head just fits into the recess at the back of the wedge, and is secured in place with a small set-bolt. Previously to this arrangement broken studs had constantly to be drilled out, entailing great trouble. This is an isolated case, where a little thought on the part of the draftsman, and a little extra expense in construction more than repays itself in time and labor saved during repairs.

The art of designing a crank axle which can be depended on with any certainty has yet to be learned. The subject can only just be glanced at in this paper. It can safely be said that any axle yet designed will in time break, not owing to the wear of any part reducing its strength, but to the constant bending backwards and forwards of the axle, and the strain produced in running over an uneven road or round curves. . . . .Locomotive axle works are unlike any other engine, therefore it is only from experience gained in actual running that much or any information can be derived. With the limited width at the disposal of a draftsman, it is very difficult to construct the webs thick enough, without reducing the axle-boxes in length. It is also very questionable policy thickening the webs. Mr. Worsdell makes his circular and reasonably thin, to allow flexure to take place with the minimum damage to the material, preferring to increase the width of web rather than its thickness. . . . .

Cylinders require very frequent repair, although the average number of renewals is only two. The valve faces are most important, and the time and labor spent over them very considerable. In ordinary inside-cylinder engines the valve faces are in between, and the space available for tools very limited. The ordinary method is to file first, with a "second cut," held at the end of a round ⅝″ bar, and the weight applied by means of a lever with a roller at the end, which presses on the file holder. The scraping is done by means of a ⅝″ steel rod, sharpened at one end into a triangular pyramid, about 3½″ long, with convex edges. This tool is supported on short rods, placed across the studs of the front chest cover, and worked up and down by hand, the uneven places being distinctly marked in the ordinary way with a surface plate and red lead. It is almost without exception the most wearying job in the repairing shop, as the author can testify from actual experience, and one of the most frequent recurrence, occasionally at intervals of six months. Great care should be taken in selecting slides so that no hard pieces of foreign matter are in them, in which case the cylinder face may be grooved to the depth of two or three sixteenths, necessitating an equal thickness being filed off all over—three or four days' work for two men, to say nothing of files destroyed. Machines, on the same principle as the horn cheek machines, have been used, and very successfully, saving something like 75 per cent. in labor. It is, or was during the author's pupilage, customary to what was termed "dot up" both valve and face when new, that is, to scrape very finely, until the bearing places when rubbed with the plate had the appearance of being dotted. This is wholly unnecessary, all that is needed is to plane the face one way and the slide the other; the first few miles' run will produce much better surfaces than any quantity of scraping. The amount of friction of valves is much more than ordinary engineers have any idea of, though perhaps not so severe as locomotive engineers have been accustomed to allow for. Mr. J. A. F. Aspinall, of the Lancashire and Yorkshire, made a most exhaustive series of experiments on valve friction, the load on the valve spindle varying from 3,713.5 lbs. to 992 lbs., the pressures being 140 lbs. and 160 lbs. respectively, the former without lubrication, the latter lubricated into the steam pipe. From these figures it will be seen how desirable it is to introduce some contrivance for reducing the friction. Material has a good deal to do with results as to the duration of valves. Phosphor bronze, brass and cast-iron being the most commonly used. Trustworthy information is very difficult to get on this subject; obviously the engine whose valve required 3,713 lbs. to move it would consume very much more material per mile than the one with the 992 lbs. The fairest way would be to put two different valves in the same engine, and with the same man. Mr. Stroudley gave the mileage of brass valves as varying between 7,000 and 77,000 miles per pound of metal worn off. He preferred phosphor bronze, and gave as the wear of his B and C class engines $\frac{1}{32}$″ per 14,460 miles. Mr. J. C. Park is the champion of cast-iron valves, and evidently gets first-rate results from them, 82,491 miles, or the life of a brass valve for a wear barely $\frac{1}{16}$″. A proof of the little friction is the fact that the drivers can handle the reversing lever quite easily with full steam of 160 lbs. Cylinder barrels require frequent attention. At each end of the stroke a small circumferential ridge is left, which has to be chipped away, and, as is the case with all horizontal cylinders, the barrel wears elliptically; with soft metal, so much so as to entail a second boring out. This is done in position with a portable machine, either driven by hand or with an endless rope. Piston rings are generally renewed at each repair, or at intervals of about eighteen months. At the same time the piston rods are turned up parallel, being naturally thinnest in the middle; the amount of wear is approximately $\frac{3}{32}$″ in that time. Glands are bored out ⅛″ larger than the rod, and have bushes, with a collar on the inside end, driven tightly in and riveted over; they are then bored out to suit the piston rod.

Very little need be said concerning the working gear. The results given by Stephenson's and Joy's valve motion are so good as to require very little improvement apart from a quicker cut-off and better distribution. Per-

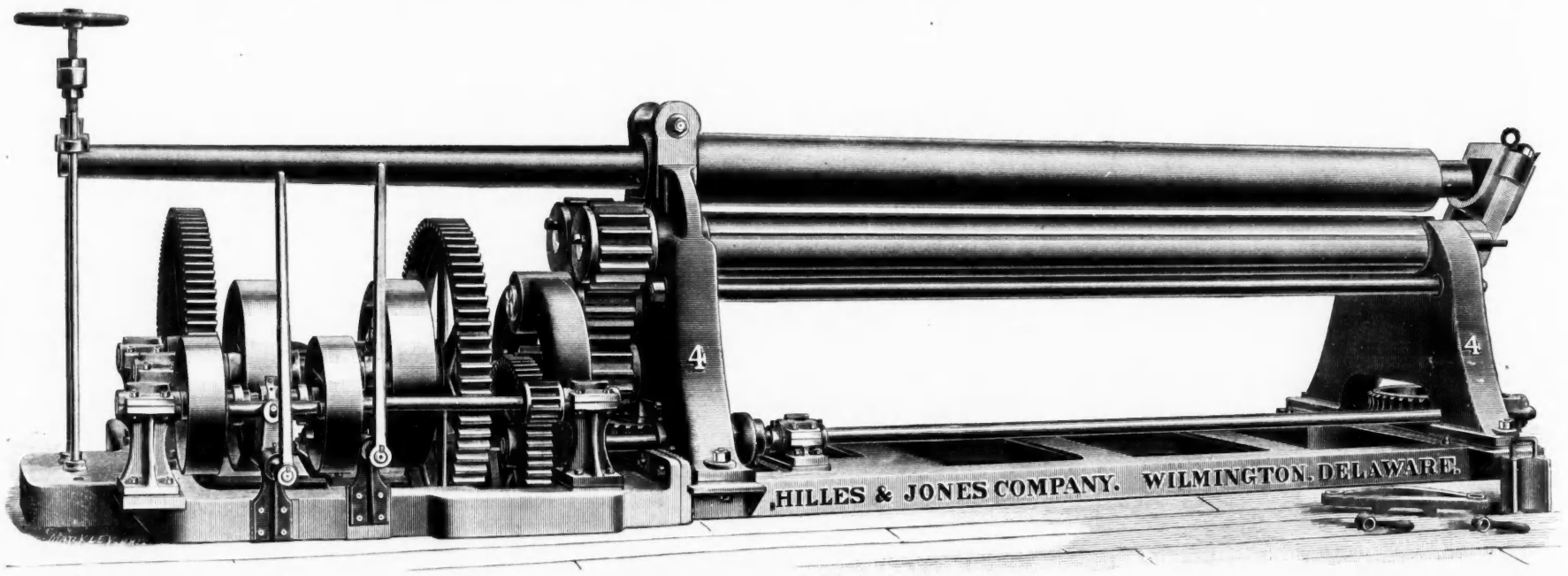


Plate Iron Bending Rolls.—See Page 1.

haps the finest result on record of the former is with the North-Eastern Railway engine No. 1175. It had up to March of last year run 800,000 miles without having its link motion in any way repaired. This is attributed to the excellence of the case-hardening, and the very large wearing surfaces. Joy's gear gives equal satisfaction; all the joints have case-hardened pins, and brass or phosphor bronze bushes. The renewal of the latter is a very simple job, and can be executed at the shed with ease. The sliding blocks are naturally the most susceptible to wear, but Mr. Webb mentions having run 126,000 miles, and the blocks still quite serviceable. Eccentrics will run for years without any setting to, and often after two or three hundred thousand miles the tool marks are still visible. Solid bushes for the connecting rod "small ends" answer very well, and are infinitely cheaper, there being no keys or straps. Mr. McDonnell introduced some "case-hardened wrought-iron little end brasses," as they were commonly termed. They needed care, and were, I believe, all taken out after two connecting rods were broken through their seizing. The gudgeon had the appearance of having been drilled into by a very large blunt drill, and the bush had a corresponding piece adhering to it. In repairing big ends the white metal is generally replaced, and the amount of wear, which in the shed is usually made up with one or more liners cast on the back in white metal.

Boilers have been so fully dealt with on several occasions before this club, that any long discourse on them would be almost superfluous. The life of a locomotive boiler is, on an average, only ten years, and during that time has to undergo many, and often heavy repairs, usually in the fire-box. The most frequent item is brick arch and fire-bars, costing. 064d. per train mile, and only ranking third in expense; tires being first, with .099d.; and springs second, with .069d. Stays cause considerable trouble, either by springing or breaking; for this reason Mr. Webb's new steel boxes will doubtless find great favor. The Great Northern fire-box life is given by Mr. Stirling as from three to five years—rather short, it would appear. The author knows many engines whose boxes have been running over ten years, and has seen boilers which have run eighteen or twenty. Of course this does not apply to colliery or works shunting engines, whose boilers run until the tubes scale solid. There can be no question as to the advisability of using brass tubes. Mr. McDonnell gives 166,937 miles as the average life of twenty-six engines, with iron tubes, and 436,964 for six engines with brass tubes, which are still in use.....

Frequency of repairs depends on the careful handling by drivers; duration after repairing on good fitters and machine men. The great question is how to insure both. It was the intention of the author to have dealt with this subject solely on this occasion. However, he hopes it will be treated in a subsequent paper. With drivers, keep them as much as possible to one engine; advance them by merit rather than by seniority; give them reasonable hours daily, rather than four days on and two off; encourage them either by bonus or prizes to run long distances without repairs, providing inspection is not left to them; have clean, warm, and healthy sheds; above all, a convenient arrangement in the weather-house and ample shelter. With workmen, treat them well; pay by merit if possible; to first-class men first-class money; enforce every rule rigidly, and avoid raising men to be foremen in the same shop where they worked if you can remove them to another. Above all, have shops clean, roomy, and efficiently warmed.

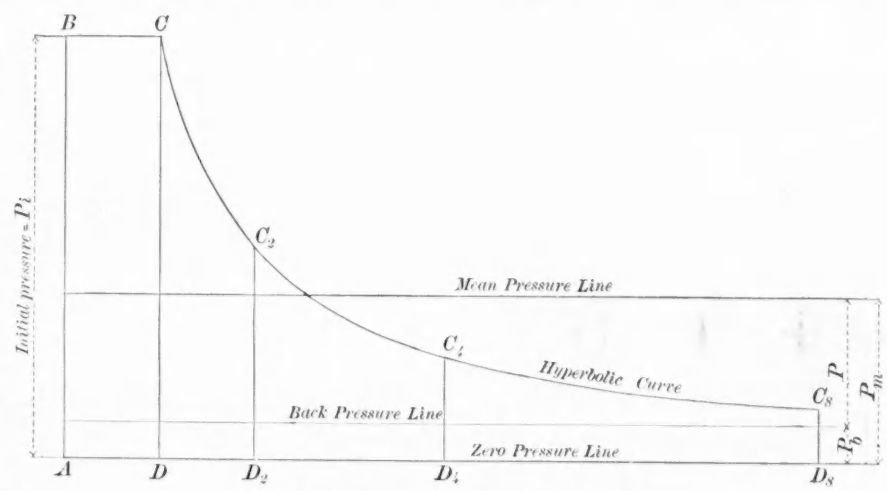
Mean Effective Steam Pressure.

In calculating the mean effective pressure of steam worked expansively in an engine, hyperbolic logarithms are generally employed. A correspondent writes us that he cannot understand what hyperbolic logarithms have to do with it. To explain the reason for employing these is the aim of the following remarks.

The accompanying figure represents a theoretical indicator diagram. Here we have assumed that the steam expands according to Mariotte's law, hence the expansion curve $C\ C_4\ C_8$ in the figure is a hyperbolic curve. For the sake of simplicity we shall neglect the clearance.

The line $A\ B$ represents the steam pressure per square inch of piston, and the line $A\ D$ represents the distance through which the piston travels from the beginning of the stroke until steam is cut off. The product obtained in multiplying the pressure line $A\ B$ by the distance $A\ D$ is the work done upon a square inch of the piston, but $A\ B$ multiplied by $A\ D$ gives us the area of the rectangle $A\ B\ C\ D$; hence we say that the area of this rectangle expresses the work done per square inch of piston by the steam in entering and in occupying the part of the cylinder up to the point of cut-off.

To illustrate, let $A\ D$ represent one foot of the stroke, and $A\ B$ a steam pressure of 45 pounds per square inch; then the area of the rectangle $A\ B\ C\ D$ represents $1 \times 45 =$ 45 foot-pounds of work done per square inch of piston up to the point of cut-off. Now, let $D\ D_2$ represent another foot of the stroke; during the time that the piston travels through this distance steam is not admitted, and the expansion of the steam performs the work, which per square inch of piston is expressed by the hyperbolic area $C\ D\ C_2\ D_2$; and, if correctly computed, we shall find it to express 31.185 foot-pounds. Here then the question arises: How can we find this area?



MEAN EFFECTIVE STEAM PRESSURE.

There are several ways of finding it; for instance, we may multiply $D\ D_2$ by the mean pressure during expansion; the product will give us the area. The mean pressure we may find by erecting on $D\ D_2$ a number of ordinates at equal distances apart, and dividing their sum by their number; the quotient will be the mean pressure during expansion. Of course the result will, at best, be only approximate, and the closeness of the approximation will greatly depend on the accuracy of the diagram and the accuracy in measuring the ordinates. All this involves considerable labor, and is therefore objectionable.

There is another way of finding the hyperbolic area $C\ D\ C_2\ D_2$, which is much simpler, from the fact that we do not require a diagram, neither do we need to know the mean pressure. This method we shall now explain, and thereby show the advantage in using hyperbolic logarithms.

We have seen that the area of the rectangle represents 45 foot-pounds, and we have intimated that the hyperbolic area represents 31.185 foot-pounds. The correctness of this last statement can easily be verified by the use of the planimeter, or by compuing the area by the roundabout method previously referred to.

Notice that we have assumed the distance $A\ D$, up to the point of cut-off, to be equal to $D\ D_2$, during which the steam expands. Under these conditions the steam is said to have *two* expansions. If we now look for this number of expansions (2) in a table of hyperbolic logarithms we shall find alongside of it the decimal .693; multiplying this decimal by the initial pressure of the steam, we have $.693 \times 45 = 31.185$ foot-pounds, which is the same as the amount of work expressed by the hyperbolic area $C\ D\ C_2\ D_2$. Here then we have found the required area in a very simple manner, without the aid of the diagram.

Let us now proceed one step further. Suppose that the length of the diagram is equal only to $A\ D_4$, and that this line represents the stroke of the engine, and $A\ D$ represents the part of the stroke up to the point of cut-off. Say that the length of the stroke $A\ D_4$ is 4 feet, and steam cut off at one foot of the stroke; under these conditions $A\ D$ will be one foot. Now the hyperbolic area $C\ D\ C_4\ D_4$ expresses the work performed by the steam during expansion; that is, after cutting-off takes place. To find this area we must, as before, find the number of expansions or the ratio of expansion. This we find by dividing the length of the stroke $A\ D_4$ by the distance $A\ D$ at which the steam is cut off; hence we have $\frac{4}{1} = 4 =$ ratio of expansions. Looking for this ratio (4) in a table of hyperbolic logarithms, we find alongside of it 1.386; multiplying this number by initial pressure of 45 pounds, we have $1.386 \times 45 = 62.37$ foot-pounds, which is also the hyperbolic area $C\ D\ C_4\ D_4$ expressed in these units, and represents the work performed by the expansion of steam only. Once more, let $A\ D_8$ represent the stroke of 8 feet, $A\ D$ the distance of one foot at which steam is cut off. The ratio of expansion will in this case be 8, and looking for this number in a table of hyperbolic logarithms, we find 2.079; and $2.079 \times 45 =$ 93.555, which is the hyperbolic area $C\ D\ C_8\ D_8$, and expresses the number of foot-pounds of work performed by the steam during expansion. The total work performed during the whole stroke is expressed by the whole area of the diagram, that is to say, it is equal to the hyperbolic area $C\ D\ C_8\ D_8$ + the area of the rectangle $A\ B\ C\ D$; and, according to the conditions of the example, will be equal to $93.555 + 45 = 138.555$ foot pounds.

Now let us examine the result. Here we have a diagram of an engine whose stroke is 8 feet, steam cut off at one foot, initial steam pressure 45 pounds. Examining the zero pressure, or base line $A\ D_8$, we find that it is divided in the following proportions:

$A\ D = 1$ foot, $A\ D_2 = 2$ feet, $A\ D_4 = 4$ feet, and $A\ D_8 = 8$ feet. The reason for dividing it in this manner is simply for the purpose of pointing out certain laws, as we shall presently see, and it is not the intention to convey the impression that all indicator diagrams must be divided in this manner.

The line $A\ D$ represents the distance up to the point of cut-off; the line $A\ D_2$ represents that part of the stroke where the ratio of expansion is 2; the line $A\ D_4$ where the ration of expansion is 4; and the line $A\ D_8$ where the ratio of expansion is 8. Here, then, the ratio of expansion increases in the geometrical progression, as 1 to 2 to 4 to 8.

Again we have seen that, under the conditions given in the example the area of the rectangle $A\ B\ D\ C$ is 45, which represents the number of foot-pounds of work done by the steam up to the point of cut-off. The hyperbolic area $C\ D\ C_2\ D_2$ is 31.185, which represents the work performed only by the expansion of the steam up to the point D_2. The hyperbolic area $C\ D\ C_4\ D_4$ is 62.37, which represents the work performed by the expansion of steam up to the point D_4; and the hyperbolic area $C\ D\ C_8\ D_8$ represents the work performed by the expansion of steam up to the end of the stroke. Here, then, we have the following areas:

45, 31.185, 62.37, 93.555.

Dividing all these areas by 45 we have

1, 0.693, 1.386, 2.079.

This shows us that when the ratio of expansion is 2, the hyperbolic area $C\ D\ C_2\ D_2$ is 0.693 times the area of the rectangle $A\ B\ C\ D$; when the ratio of expansion is 4, the hyperbolic area $C\ D\ C_4\ D_4$ is 1.386 times the rectangle $A\ B\ C\ D$; and when the ratio of expansion is 8, the hyperbolic area $C\ D\ C_8\ D_8$ is 2.079 times as large as the rectangle $A\ B\ C\ D$. Tabulating these results we have

For ratios of expansions	2,	4,	8,
the successive hyperbolic areas in comparison with the rectangle will be	0.693,	1.386,	2.079.

But the hyperbolic logarithms of

2, 4, 8,

are 0.693, 1.386, 2.079.

This indicates the use and advantage of hyperbolic logarithms; for if we know the ratio of expansion we find its hyperbolic logarithm, which tells us at once the ratio between the hyperbolic area and the rectangle which represents the work performed before the cut-off takes place.

To make this plain, let us take another example: Suppose that the diagram represents an indicator card from an engine whose stroke is 3 feet, cutting off at 6 inches or .5 foot; and initial steam pressure 30 pounds per square inch. In this case the distance $A\ D$ is .5 feet, and $A\ D_8$ is 3 feet. The ratio of expansion will be $\frac{3}{.5} = 6$; and the hyperbolic logarithm of 6 is 1.792, which shows us the hyperbolic area $C\ D\ C_8\ D_8$ is 1.792 times as large as the area of the rectangle $A\ B\ C\ D$.

Here the line $A\ D$ represents one expansion as in the previous example, hence $A\ D$ must be taken as unity = 1; therefore the area of the rectangle will be 30 and hyperbolic area $D\ C\ D_4\ C_4$ will be $1.792 \times 30 = 53.76$, and the total area of the diagram will be $30 + 53.76 = 83.76$, which is total amount of work performed in foot-pounds.

Now when we know the total amount of work in foot-pounds, which the diagram expresses, we can easily find the mean pressure by dividing the total work by the length of the diagram. The length is expressed in the number of expansions, which, in the last example is 6; hence we have $\frac{83.76}{6} = 13.96$ pounds per square inch of piston. It must be noticed that this pressure is absolute; that is to say, it is the pressure indicated by the steam gauge plus the atmospheric pressure = 14.7 pounds. To obtain the mean effective pressure we must deduct the back pressure also reckoned from the zero pressure line. If this back pressure is 4 pounds, then the mean effective pressure will be $13.96 - 4 = 9.96$ pounds per square inch of piston.

In conclusion it may be remarked that the use of a table of hyperbolic logarithms is analogous to the use of a table of circular areas. If we know the diameter of circle, and wish to find its area, we find it at once in the table of circular areas. On the other hand, if we know the number of expansions we refer to a table of hyperbolic logarithms, which tells us at once how much less or greater the work performed will be after cut-off than that performed before the cut-off takes place. From the foregoing remarks, we can establish the formula given in engineering works for finding the mean pressure of steam working expansively.

Let r represent the ratio of expansion, which is always obtained by dividing the stroke by the distance through which the piston travels before cut-off takes place; $\log_a r$ the hyperbolic logarithm of r; P_i the absolute initial steam pressure; a the distance through which the piston travels before the cut-off takes place; and P_m the mean pressure per square inch; we have

$$\frac{(a \times P_i) + (\text{hyp. log. } r \times P_i)}{r} = P_m.$$

But since a is always assumed to be equal to 1 we may simplify the foregoing formula, and state it as follows:

$$\frac{(1 + \text{hyp. log. } r)}{r} P_i = P_m.$$

If from this mean pressure we deduct the back pressure, we obtain the absolute mean effective pressure per square inch.

Making Worm-Wheel Patterns.

By P. S. Dingey.

A worm-wheel pattern is not an easy thing to make, by any means; it is that kind of a job on which a good man is apt to go astray.

Figs. 1 and 2 represent a wheel to be made; the worm is shown in gear, and, as I have already referred to it in some of my recent communications to the American Machinist, I will confine my remarks to the wheel pattern, except that reference will have to be made to the angle of the thread of worm.

The dimensions are the first thing to be determined. Let the wheel be 21¾″ diameter, 1¾″ pitch, 39 teeth, form of tooth involute, laid out with the aid of Prof. Willis' odontograph.

Pattern makers generally shape the thread of a worm pattern the same as the tooth of the gear in which it is to work; but I think it is better to make the sides of the thread straight, at an angle of 75° with the axis of worm. This is correct for an involute, because that is what a rack tooth would be, and the worm is similar to the rack in this case. A section of the wheel pattern is shown in Fig. 3; the rim is first built up and turned straight on the outside, the pattern being parted on line *A B*.

A little thought will have to be exercised in building and turning the rim so as not to do any unnecessary chucking. In the first place, the face plate for turning it should be about the same diameter as the rim, so as to allow the ends of the teeth to be turned off. Lay each half up separately, with the parting joint of pattern against the face plate, rough off the outside and finish the inside of both halves, care being taken to turn the inside of both halves the same diameter, because of the chucking. This done, the rings are chucked by the inside, and, to do this, segments are nailed on the face plate. The outside of the rim should now be finished to the size required, and blocks for the teeth fitted on the periphery. These blocks should be fitted and glued on with the grain of the wood running the same angle that the teeth are to be at the pitch line, the width of each block being the same as the pitch. The way to get the angle is shown in Fig. 4, *y* representing the angle of tooth at the pitch line. These blocks are fastened on before taking the first half out of the lathe, and a groove turned on the joint for locating the halves concentric with one another. When the second half is chucked and turned, and the blocks for teeth fixed on, as in the case of the first half, a projection is turned on the joint of it to fit the groove on the joint of the other. The two halves should now be put together, and the blocks for the teeth turned off on the ends, and finished, as seen in section Fig. 3. It will make a good surface for marking out the teeth to varnish these blocks with yellow varnish.

In Fig. 1 a part of the pattern is shown cut through line *A B*, Fig. 3; the other part with the three teeth represents the outside and ends of the teeth. In theory the teeth will be thinner on the ends than they are on the parting line *A B*. In practice this is not generally considered, because it would make it difficult to draw the pattern if made that way; the teeth in cast gears are therefore made the same thickness on the line *C* as on the pitch line *D* in Fig. 1.

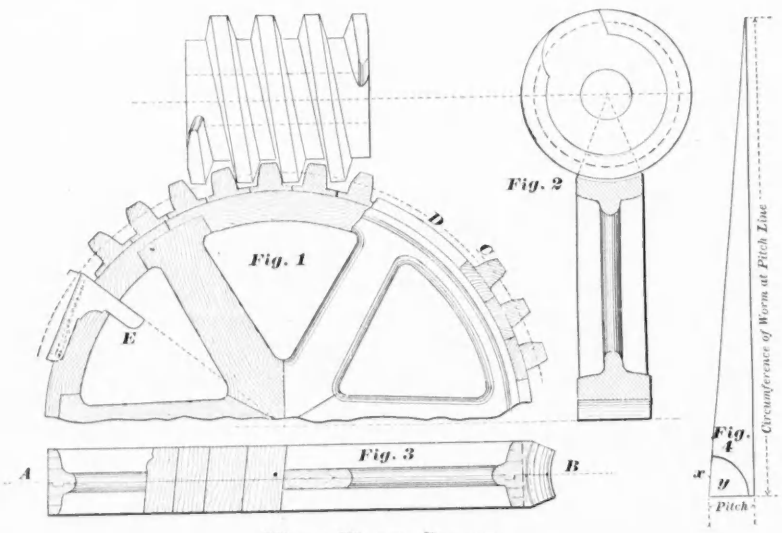
The odontograph for locating a center for marking out the teeth is shown at *E*, Fig. 1; the instrument is nothing more than an angle of 75° spaced off in ¼″ on one side for 4″ in length, the ¼″ spaces being divided again. Zero on the instrument is placed at a point on the pitch line, and the plain side is set to a radial line; the radius of the gear is then read off on the graduated side, which will locate a center from which to strike the tooth. In this case the wheel being 21¾″ diameter, the radius is 10⅞″; read off 11, which is near enough for all practical purposes.

To lay out the teeth on the pattern at the proper angle, take one of the joints of the blocks and space off half the pitch on each side of the wheel on the pitch line. If these pieces for the teeth have been made to the angle of *y*, Fig. 4, these points on each side will be the starting points for dividing the teeth, and will give the angle of tooth.

If the teeth are marked out also on the joint of one-half of the pattern, and trimmed down to the line, it will be an additional guide to cut the teeth by.

It is said by the highest authorities on worm gears that the tooth should not only be thinner on the ends than in the middle, but that the profile is also different, because, in Fig. 1, the line *C* being farther from the center than line *D*, travels faster. But the difference is so slight that for cast gears it amounts to nothing, and need not be considered by the pattern maker at all.

The fact of the arms of the pattern being in halves makes them thin, and therefore weak; but if the joints in the center be tongued, and the hub on each side glued and screwed to the arms, it will strengthen them considerably.



Worm Wheel Pattern.

Note on Gold Mining and Milling in Korea.

By Willard Ide Pierce, New York City.

(A Paper read at the Washington Meeting of Mining Engineers.)

The native methods of mining and milling gold ores in Korea may not present any specially new features, but are chiefly interesting as primitive practices, still followed at the present day.

In mining where the rock is hard, wood is piled up near the face of the tunnel or drift, and then set on fire. The fire burns for twenty-four hours, after which three or four days are given for the rocks to cool before the miners go in and extract the loosened material. The only tools in use are a hammer, a steel gad about five inches long, and a flat spoon-shaped basket. The pay streak, or chute, is closely followed, and in places the workings are very small and intricate. Rock not yielding more than $6 per ton is not extracted. The manner of opening a mine is to begin on the outcrop, where the rock pays, sink a shaft or run a tunnel on the vein, and follow the pay streak and more easily worked ore. When this is exhausted, or the influx of water interferes, the opening is abandoned, and operations are begun again at a new spot on the outcrop. The place usually selected is as high up on the mountain as possible, and in no instance is advantage taken of the topography by running a cross-tunnel to tap the vein.

The ore is brought in baskets to the surface, and there placed in sacks, holding about 150 pounds each, and taken to be crushed. The rock is first crushed between two stones . . . . . The upper stone is oval, and rounded on the bottom, so that it can be readily rocked on the under stone. Two pieces of wood, used for handles, are placed, one on each side, in grooves in the upper stone, and held in position by means of straw rope. The lower stone is not smooth on top, but exhibits three elevations running lengthwise, with shallow depressions between them. The middle elevation acts as a fulcrum on which the upper stone may be rocked. From two to ten men, according to the weight and size of the stone used, are employed in rocking. With four men from 300 to 350 pounds of rock can be crushed per day, the stone making 50 complete oscillations per minute. The men squat on each side of the stone, and move it to and fro by means of the wooden handles. The ore is fed in pieces up to the size of an egg, or even larger, by one of the men. During the crushing, one man on each side, as the stone rocks from him, uses a stick as a scraper to stir the crushed rock. When the ore is fine enough it is swept out on a piece of cloth, placed at one side of the stone, the rocking being continued all the time. After a certain amount has been crushed, it is usually put through a horsehair sieve, and the coarser portion is treated again. An upper stone, intended for four men, measured 23 inches in length, 20 inches in width at the base, and 15 inches in height. Crushing is usually performed in sheds, to prevent the wind from blowing any of the fine stuff away.

The crushed ore is taken to men who rub it between stones until it is very fine; the rubbing is generally done wet. The powdered ore is received by other workmen, who pan it and save the free gold. The pan is of one piece of wood, 20 inches in diameter and 5 inches high; and the men who use this instrument are the most expert panners I have ever seen. The pan is not held in the hands, but floats on the surface of the water, one side only being raised or lowered to agitate the contents. As the pulp is very fine, and the gold in the same condition, the top of the water in the pan is frequently sprayed, so as to settle any gold that may be floating. The first tailings are washed off directly from the right-hand side of the pan. After this the sulphurets and gold are collected on the right-hand side of the pan, and the tailings on top of the sulphurets are, by a few skillful movements, washed over to the left-hand side. The pan is then half revolved, and the tailings are washed off from the right-hand side. The same operation is repeated after the tailings have all been removed with the sulphurets and gold, the former being saved and again rubbed. No quicksilver is used, but I do not think that there is any loss in free gold.

A correspondent of the *Railway Age* declares that honest conductors have little to fear from the spotter—a statement which is editorially endorsed.

We beg to differ, however. Spotters are unknown. They never face those whom they accuse, and are without responsibility. They must convince the companies who employ them that they are earning their salaries, and, of course, must occasionally "spot" some one, who is discharged without any distinct charges being brought against him, but with the stigma of a thief. The spotting system, as at present carried on, is a cowardly piece of business, giving men who have little or no sense of honor, an opportunity to work out their petty personal spites, secure from attack by their victims. If a conductor is caught stealing, let him be openly charged with stealing, and prosecuted for it, not charged with it in such a way that, no matter how innocent he may be, he has no chance to defend himself.

The Labor Conference at Berne.

A conference is to be held at Berne, Switzerland, under the auspices of the Swiss Government, to discuss matters relating to labor. It is expected that the leading nations of Europe will be represented. Following are the subjects to be discussed, as officially given out:

First. "Prohibition of Sunday labor." To what extent is there occasion to restrict Sunday labor? What are the industries or methods of work with regard to which, from their very nature, interruption or suspension of labor is out of the question, and Sunday labor must therefore be permitted? Are there in these industries any measures to be taken with a view to securing Sunday rest for the workmen taken individually?

Second. "Fixing the minimum age for the admission of children to factories." Is there occasion to fix a minimum age for the admission of children to factories? Should the minimum age be the same in all countries, or should it be fixed with consideration for the physical development, more or less precocious, of the child, according to the climatic conditions of the different countries? What is the minimum age that should be fixed in each of the two cases? May exceptions be admitted to the minimum age when once fixed if there is a diminution in the number of the working days, or the length of the day's work?

Third. "Fixing of a maximum day's work for young workmen." Is there occasion for fixing the maximum length of a day's work for young workmen? Are the hours of compulsory school attendance to be included in such a day's work? Ought this maximum length of a day to vary according to age? How many hours' work, with or without effective intermissions, ought the maximum day to contain in either case? Between what hours of the day ought the time for work to be fixed?

Fourth. "Prohibition of the employment of young persons and women in occupations which are particularly detrimental to health, or are of a dangerous character." Is it necessary to restrict the employment of young people and of women in occupations which are particularly unhealthy or dangerous? Ought persons included in these two categories to be absolutely excluded from such employment? If so, up to what age? Or only in part, *i. e.*, to a certain age for young persons, and at certain times for women? Or should the length of the working hours for young people and of women employed in such work be reduced? What are the minimum requirements to be adopted in the two last named cases? What are the unhealthy or dangerous employments to which the above restrictions are to apply?

Fifth. "Restriction of night work for young persons and women." Should young persons be excluded entirely or only partially from night work? Under what conditions can they be partially allowed to undertake night work? Should women be entirely excluded from night work, without distinction of age? In the event of their being permitted to undertake such work, is there occasion to make certain restrictions? What hours of a day's labor are included in the term "night work," or, in other words, when does night work begin and end?

Sixth. "The putting into practice of the regulations adopted." To what descriptions of labor establishments—mines, factories, workshops, etc.—are the regulations applicable? Should any term be fixed for the carrying out of the regulations adopted? What measures are to be taken to insure their being carried out?

It is said that a man in Woodhull, N. Y., has secured a patent on making hemlock trees yield bark perpetually. Ordinarily,

stripping the bark from a tree kills it; but this Woodhull inventor applies a solution to the tree, after peeling, that excludes the air, and the result is a new crop of bark the next year.

New Pipe Wrench.

With this we give an illustration of a new pipe wrench, which has recently been invented, and is being introduced by Mr. J. D. Hodge, of 456 S. Market street, Newark, N. J.

It will be seen that the improvement in this wrench consists in providing it with a sliding jaw having teeth which engage with the pipe or stud to be turned, and prevent slipping.

The opening left between this sliding jaw and the hook, when the tongs are closed, is regulated by means of the milled nut by turning which the square-threaded screw is moved in or out, and by means of the connecting link moves the jaw.

The ends of the link have a solid bearing in the jaw and screw respectively, the pins serving merely to draw the jaw back, and are unstrained by use.

The strap used to hold the sliding jaw in place is also not subjected to any strain, when the tongs are in use, as the tendency is simply to seat the jaw firmly in place.

The grip is very solid, with an instant and easy release.

Three sizes are made. to take $\frac{1}{4}''$ to $\frac{3}{8}''$; $1''$ to $1\frac{1}{2}''$; and $1\frac{1}{4}''$ to $2''$.

The Northwich Boiler Explosion.

In our issue of January 3d last we referred to the formal investigation then just concluded by the Board of Trade with regard to the boiler explosion on board a steamer belonging to the Salt Union, Limited, this explosion having taken place on the River Weaver, near Northwich, on October 19th, and having resulted in the death of the engineman. The official report of this investigation has now been published, and from the extracts which we give on page 203 of our present issue, it will be seen that the conclusions arrived at are of special importance to the general public.

The report states that the explosion was caused, as we have already informed our readers, by an undue pressure of steam, "the safety valve having been rendered entirely inoperative by a wooden wedge which had been inserted between the top edge of the lever and the top of the guide bracket." That the insertion of this wedge was the act of the engineman, in order to increase the pace of the vessel, admits of little question, and he was thus simply the victim of his own foolhardiness.

Were this a solitary case we might pass it by with perhaps merely an expression of surprise that any man possessing but a rudimentary knowledge of mechanics, or even ordinary common sense, should adopt so insane a practice as that of wedging a safety valve, and thus practically robbing the boiler of that absolutely necessary safeguard. But when a trained engineer, like the one at Northwich, performs this mad feat, and when we learn, as the report adds, that "it is a common practice for engineers employed on vessels plying on the River Weaver to tamper with the safety valves under their control," we are led to inquire what steps can be, or ought to be taken to prevent such criminality, and how such offenders can be most effectually restrained, and some other field laid open to them for the exercise of their misdirected and surplus energy? If only their own lives were at stake we might have less reason to utter our protest, but by their willful act they risk the lives of those who have no possible connection with the boilers under their charge, the safety of which is thus jeopardized, and who are, therefore, in danger of being innocent sufferers for the wrongdoing of others, so that it is in the interest of the helpless that some protective measures should be instituted.

These small steamboats, fitted with boilers having but a single safety valve, attended in many cases by a so-called "engineer" possessing the dangerous tendency to tamper with his valve, are by no means limited in their operations to the River Weaver. They ply on many seas, rivers and canals, and their name, we fear, is legion. They call at various docks, piers, wharves and stopping places on their way, and all those persons living near, or who have business in the neighborhood, have their lives imperiled so long as they remain there. Why should the public be at the mercy of a reckless engineman and a wedged safety valve? Surely it is most important, as the Commissioners remark, that such boilers should be fitted with safety valves that cannot be tampered with, or, at all events, not easily. The cost of a trustworthy lock-up valve, which does not admit of the application of the tampering art, is so small that no boiler on board a steamer should be without one, and, if the owners of these vessels are not inclined to adopt the simple precaution voluntarily, we consider, in the words of the Board of Trade report, that "the Legislature might interfere to compel them." Indeed, we should be inclined to go further, and to say that is the duty of the government to legislate for the protection of life and property in this matter, and to safeguard the interests of those at present endangered. Passenger steamers are surveyed by the Board of Trade, and we are of opinion that some equally efficient system of inspection should be applied in the case of these smaller craft, such as merchant or trading vessels, tugboats, fishing smacks, etc., so that a repetition of the Northwich explosion may be rendered practically impossible.—*Engineering.*

NEW PIPE WRENCH.

New Quarters for the Mechanical Engineers.

Less than ten years ago about 30 mechanical engineers met in the office of the AMERICAN MACHINIST to take means to bring about an organization. The number that met was small, but there were present some of the best known engineers in the country. This meeting resulted in forming The American Society of Mechanical Engineers. At the present time the membership of this society is about eleven hundred, and is rapidly increasing.

The almost phenomenal growth of the society has made the question of suitable accommodations a prominent one, and headquarters have been changed from time to time, as the Council has found necessary. But recently it has been found that another move must be made, and this time it is thought wise that the move be to rooms owned by the society. With that end in view, the society has purchased the property No. 12 West 31st street. This property was, before the purchase, in possession of the N. Y. Academy of Medicine, and the rooms will be remembered by the members of the society as the place where the last three meetings have been held.

Part of the premises has already been rented to the American Institute of Electrical Engineers. When the two societies occupy the building, the arrangements are such that the libraries of each will be accessible to the members of both societies. The Council sets forth the advantages of the step taken as follows:

1. Better return for a given outlay, whether paid as rental or interest.

2. Adequate accommodation, especially for the library, but also for all the uses of the Council and membership. This accommodation will make better provision for any work of investigation by the society.

3. Membership in the society becomes of enhanced value, by reason of the facilities which its home will offer, and the increased prestige given.

4. Increased dignity, position and influence is given to the society as an organization. This tends to elevate its standing, both at home and abroad, and to secure for its members, and for mechanical engineers generally, a higher and broader recognition.

5. Permanency of location and of facilities gives added usefulness for the society to its whole membership, especially to the non-resident portion, always the larger part.

A large part of the purchase money will be obtained by a mortgage on the property. About $30,000 remains to be raised on bonds to be issued, each for $100, bearing interest at five per cent. It is thought best by the Council to issue bonds of small denomination, so that they will be taken by the members generally, rather than by a few. A member taking $200 in bonds will receive yearly in interest a sum equal to his yearly dues.

The dues of this society are remarkably low. The transactions of the society are furnished bound, and the cost of this volume, together with the dues, is only eleven dollars yearly; the bound volume is cheap at that price.

It is not proposed to increase the dues, but, for the special occasion of purchasing the property referred to, the Council believe that the members generally will voluntarily pay five dollars more each year, in which case the bonds would be retired in about six years.

This, in brief and in part, is an outline of a plan whereby the American Society of Mechanical Engineers will own its own building in an almost ideal location. That it can do this so soon after organization is a matter for congratulation.

"How many horse-power does it take to run the road?" asked Snaggs of the Superintendent of the power house. "My dear," interrupted Mrs. Snaggs, before the Superintendent could answer, "you surely do not mean horse-power. This is a cable road, you know."—*Pittsburgh Chronicle.*

A Pump Problem.

BY W. H. BOOTH.

I am assured by the engineer of a woolen mill that there is a vertical depth of no less than forty feet between the injection inlet of the condenser of his engine and a platform down a well, from which the condenser will "draw" water until the said platform is dry.

My informant is not a man who is ignorant of such matters. He is perfectly aware that such a thing is unexpected, and states not only that he has carefully checked his measurement, but that the man who supplied the vacuum gauge also made a measurement himself, in order to show that the previous measure must have been wrong, but was proved correct.

As yet I have had no opportunity of testing the matter for myself, but believe my informant is correct. Seeing that a 27-inch mercury vacuum is only good to support a column of water considerably under 30 feet in height, some explanation must be possible for the extra 10 feet.

Assuming the possibility of the occurrence, the only explanation which appears feasible to me is that the water, like much other water from the coal measures in which the well in question is sunk, is highly charged with gas—probably carbonic acid—and that when such water enters a pipe in which the pressure gets less and less as the water ascends to the condenser, the gas is set free just as it is on the removal of the stopper of a mineral water bottle. Actually, then, the forty feet of pipe is filled, not with solid water, but with an effervescent mixture of gas and water, the amount of water being actually insufficient, if packed closely, to fill even thirty feet of the pipe. Such being the case, it is very easy to explain the seeming puzzle, and perhaps others have already had the experience and found the cause.

It leads me to think, however, that perhaps engineers have allowed themselves to be too closely tied by the customary 30 to 34 feet of water as being the maximum possible suction depth; they have known the theoretical depth, and have refused to even look at a lower depth of water, and perhaps gone to expense in pump rods, etc., before trying whether it is practicable to utilize the gaseous property of expansion.

It is easy to see that a forty-foot pipe, containing alternate plugs of water and gas a foot in length, will have a virtual head of only 20 feet, and be readily made to draw water out of a forty-foot well. There is no special outlet in a 34-foot column, unless such column be solid water. Oil, for example, may be pumped 34 feet plus about one-ninth of 34 feet, and why should not water flow up a height of 100 feet, if sufficiently let out by alternating plugs of air? Given only a means of taking away the air at top, as is done by the air pump of a steam engine, a water supply might be rendered available for condensing purpose, by the simple expedient of a small inlet pipe of air being taken down to the injection pipe near its lower end. Once start the engine and condense a short time from a surface store of water, and the deep well supply could be gradually put on; first letting it draw air in large quantities, and then gradually opening up the water supply and closing the air tap until the minimum air supply was being admitted.

There is, of course, to be considered the effect on the vacuum of this air admission, and it would be a matter for consideration whether it would be cheaper to employ pumps to lift the injection water to within the usual 18 or 20 feet below the condenser, or to use air as above suggested. If air be used, then the air pump might be proportioned accordingly, and there would be saved the expense and friction of lift pumps at the cost of a certain diminution in the vacuum. When water is being simply raised for other purposes than condensing, it appears quite rational to suggest that the use of air to reduce the virtual head of lift would prove beneficial.

Clearly the limit of height at which it would be possible to carry out the idea would be that at which each plug of air admitted at the pipe foot would expand to such a rarity that the back space of the pump bucket would not be enough to take the volume. In such case, no water would be drawn at all. The practicable limit would be much lower than this, and any possible economy in the method would cease.

LETTERS FROM PRACTICAL MEN.

License and Boiler Inspection Laws.

Editor American Machinist:

In your issue of Feb. 27th I see an article in which you say there are "periodical attempts to pass laws to license engineers and inspect boilers," and so on, and that these advocates always begin at the wrong end. Now, Mr. Editor, I would like to know what you term the right end, for I would like to know how we are to show the ignorance of those in charge of such death-traps as are scattered all over the country, in the shape of old steam boilers, unless we have something in the shape of license or inspection laws that will compel the people to show themselves as knowing at least something about those same death-traps at which so many of the *educated* are at work. I would like to know how you are going to make any one see the "utility" of a thing that will, in his estimation, cause him to pay more for the same article, for it is those who are in total ignorance of the benefits of such laws that are the ones that do the most kicking. They fail to see that, if there was a law that compelled all engineers to be examined before they could work at a business, that the law itself would be the educator.

You say, let the engineers begin at the right end. What is the right end but the

securing protection for the fraternity by legislation, so that they will be recognized?

I have been an advocate of having those things regulated by legislation for some time, and I think it is high time that men of the throttle arose all over the country and demanded examination and inspection laws from their respective legislative bodies. I, as an engineer, know what a benefit it is to have even as little legislation on the subject as we have here in Ohio, and I think that there is hardly a mill proprietor but what has found out that he is getting a better result out of his engineer since, than he did before; for it has compelled them to brighten up and study about their business.

I have always been a friend to the AMERICAN MACHINIST, and I don't like to see so able a friend, as I have always thought it to be to the engineer, so forcibly doubt the "utility" of one of the best laws any State could possibly enact, and if the engineers had the sympathy and help of all of the papers that are largely supported by them, I think they wouldn't have such a hard time to show the "utility" or "begin at the right end" either. LICENSE LAW.

[Our correspondent who elects to be known as "License Law," which is a good enough name, takes us to task for what he considers our wrong views on license laws for engineers, using for his text an editorial note that appeared in our issue of February 27. We refer to this matter again because we believe "License Law" labors under a misapprehension as to our views. We believe if he would carefully read again the short note to which he refers he would see the whole matter quite differently.

It seems almost unnecessary to say that the AMERICAN MACHINIST has never opposed license laws for stationary engineers. On the contrary, it has always advocated them. But, as we said in the note which has been referred to, "The people are not educated up to the point of seeing the utility of such laws, and, until they are, it is impossible, in the first place to pass them, and, in the second place, to enforce them."

It would "possibly" do no great harm for "men of the throttle" all over the country to demand inspection laws, and it would probably do no good just now. While stationary engineers form a very important part of the population of the United States, they constitute only a very small percentage of the voting population.

If all engineers (and we believe all the best ones are in favor of such laws) were to unite in demanding inspection and license laws, they would not succeed without the assistance of those who own the boilers, and the public generally. The legislators of a State may be labored with until they honestly believe in the wisdom of an inspection and license law; but even then they will not enact such a law unless they are satisfied that a majority of their constituents are of the same way of thinking. They are elected to represent their constituents, and they are looking for re-election or promotion.

What we meant by beginning at the right end is beginning at the educational end. Get people other than engineers to see the advantages of intelligent inspection and care of boilers; get them to see the danger of present methods; then, and not till then, can inspection and license laws be enacted and enforced.

Our correspondent, thoughtlessly, we are sure, quotes us, in his last paragraph, as expressing doubts of the utility of such laws. It is hardly necessary to say that we did nothing of the kind.]

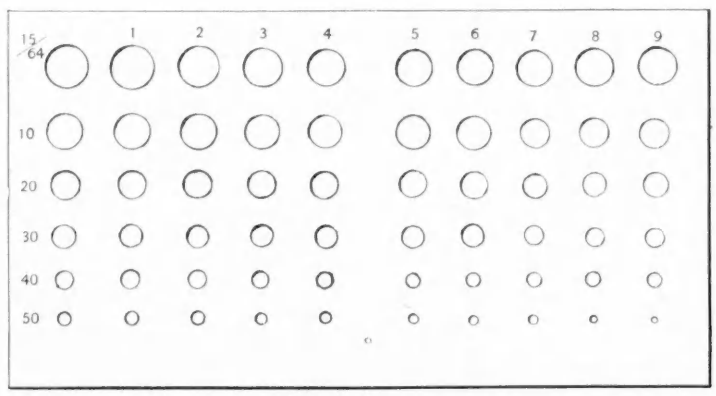
Hints in Pattern Making—Boxes—Boiler Front—Fillets.

Editor American Machinist:

In Fig. 1 I have shown the top half of a box patttern, which I make as follows: From a nicely dressed board I saw out—in the shape of *b*—pieces enough to make the box the desired length, and, in case raised bolt seats are wanted, I put in a course thick enough to form the part *a*, gluing the course together, and finishing when dry. If flanges for holding babbitt are wanted, the outside courses I make from thin stuff, say $\frac{3}{16}$" or $\frac{1}{8}$" thick.

Box patterns made in this manner stand a great deal of hard service, and are not materially affected by changes of weather, etc. When the chamber is planed out, the grain running parallel to the axis of the chamber, the pattern is almost certain to warp, and the halves of the box fit badly when put together.

In Fig. 2 is shown part of a boiler front pattern. In making a pattern of this kind, the grain probably runs as shown by the arrows. The joints of the cross-pieces *M N* should be along the line *c d*, passing through the centers of the circles of the fillets, and not along the line *e f*, which is tangent to them. If the joint is at *e f* it will be necessary to set in a piece, as at *a*. I know of one pattern made on the latter plan, and I suppose I have put new corners in it every time it has been used in the last two years.



DRILL GAUGE.

Some writer in the AMERICAN MACHINIST gave some good advice about fillets, but I do not think he gave the method illustrated in Fig. 3. This can frequently be used if a little thought is taken. In T and angle irons, and, in fact, in nearly all webbed patterns, instead of making the joint along the dotted line, get out a piece like *A*, Fig. 3, with the joint at *a b*. This is far better than any fillet that can be put in a sharp corner; not only that, if fillets must be made this method is the shortest, especially if a good saw table is at hand. I do not suppose this is anything very new, and some will say any one ought to know all that, and probably all experts in the business do; but it is the sinners who should be called to repentance.

A. L. BOWEN.

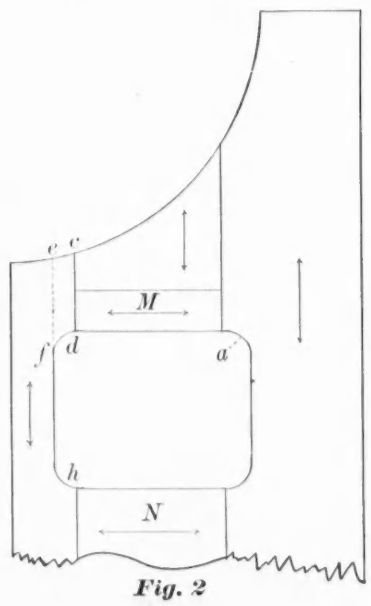


Fig. 2

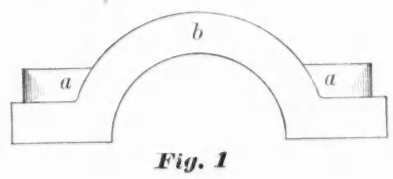


Fig. 1

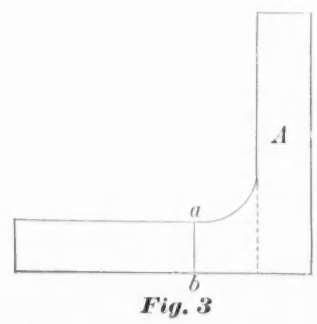


Fig. 3

PATTERN MAKING.

Emery Wheels.

Editor American Machinist:

I do not wonder that a reaction is taking place in many minds against the use of emery wheels for tool grinding; for there seems to have been, in the past, a remarkable misunderstanding of their true merits, and a lack of discrimination in selecting wheels has been apparent both in dealers and consumers. This order of things, I trust, is fast becoming a thing of the past, as people begin to more fully understand the requirements of emery grinding, and the advantage gained by employing special tools for special purposes.

As your correspondent—Mr. Norton—suggests, our ideas of emery wheels have formerly been much influenced by our familiarity with polishing wheels, and I fear we have not yet fully evolved from that state of mind; hence we see many emery wheels run at dangerously high velocities. It follows, as a consideration of safety, that these wheels must be made of a hard grade, or constructed with a connecting band of great toughness, both of which qualities impair the cutting properties of a wheel.

It is obvious that about all the energy employed to force work in contact with a hard emery wheel is converted into heat, and the familiar *blued* job is the result. To avoid the generation of heat (a difficulty common to all grinding operations), recourse has been had to cold water, a stream of which is made to saturate the grinding wheel, the work held in contact with the same, and lastly, the operator.

An emery wheel has been likened to a "revolving file." The similarity, as far as regards a hard wheel, is very evident; for, like a revolving file when the cutting points are worn off, it becomes a burnisher. The best work can be obtained from a grinding wheel only when the particles, after having done their work (generally being pulverized), give place to fresh particles, and maintain a constant fresh abrasive surface, the wheel wearing away to a certain degree The degree of hardness of an emery wheel will, of course, determine the amount of wear upon the same, and it should be varied according to the kind of work being operated upon.

For grinding thin-edged tools, such as knives, chisels, gouges, etc., a very soft and medium coarse grade of wheel should be employed; for removing surplus metal, and for the final edge, use also a very soft wheel, but a much finer grade. Thus a double wheel grinder is found desirable, but the improved results will be found to more than compensate for the investment. If a good choice of wheels has been made, they may in all cases be used *dry*, and with a consequent increase of satisfaction. Wheels suitable for grinding lathe and planer tools should be of a harder grade than the ones previously mentioned, while, for grinding thin plate, pointing wire, or grinding between the grooves of taps and reamers, a wheel is required much harder still. Thus we might go on indefinitely, and name an endless variety of operations requiring special grades of wheels to give best results. As Mr. Norton intimates, there are "great possibilities" for utilizing cutting particles when formed into special shapes and grades for special purposes. In sizing cylindrical work in a grinding lathe, a wise discrimination is required to select the best kind of wheel for the purpose, it being always best to use a grinding arbor of as large a diameter as practicable, and a proportionately large emery wheel; in fact, an emery wheel should never be *over-worked*. A grinding operation that seems to present many unsatisfactory results is that of grinding the inside of small boxes where there is no alternative but to use small wheels and a small arbor. The tremendous velocity necessary to maintain a sufficient surface speed of the emery wheel, and the utter disproportion in size of emery wheel to the superficial area to be ground, make an insurmountable combination of obstacles. With great care, however, emery wheels are used as small as one-quarter inch in diameter. Below this we enter the field of the diamond lap. What is demanded by the grinding public is an emery wheel at a considerably less price, and a good substitute for the diamond truing tool. O. S. WALKER.

Drill Gauge and Drill Rack.

Editor American Machinist:

Several years ago I made myself a drill gauge like sketch, which, I think, possesses some advantages over the ordinary style. Those of your readers who have occasion to use a table of logarithms, know how easy it is to pick out just the number they want from a page where the figures are as thick as the hairs on a blacking-brush. This gauge is arranged somewhat on the same plan; there are ten vertical rows of holes, and six horizontal rows, numbered along the top and down the left-hand side. It will be observed that No. 1 is not in the corner, but is next to the corner hole (which is 15-64). This arrangement brings all the 20s in one row, all the 30s in another, all the 40s in another, and so on, leaving 60 all alone at the bottom. The number corresponding to any hole is the sum of the one directly at its left, and the one directly over it, or the units at the top and tens at the side. This may seem cumbersome to those who have never used it; but, after getting accustomed to it, the hole is found by its *position* on the plate, or, conversely, the number corresponding to any hole is known without reference to the figures.

But the greatest gain is secured when the rack to hold the drills is laid out after the same plan, as then the rack don't have to be numbered, each hole having a *similar position* on the gauge and rack. A drill rack generally gets its share of any dust and dirt that may be flying about, and this covers up the numbers of the ordinary rack, which can't very well be cleaned without removing all the drills. My rack is made of hard rubber, which doesn't show the accumulated dirt quite so badly as a wooden one, and doesn't swell up in damp weather and cause the drills to stick tight. The sketch of gauge is full size, but the rack is larger—about 4x5x$\frac{1}{2}$. WALTER GRIBBEN.

An Adjustable Isometrical Parallel Ruler.

Editor American Machinist:

It has been said that many a youth of promising intelligence has been dwarfed by giving him a name bigger than he could carry. It is said that if such or such a one had not been named Julius Hannibal Cæsar he might have shone—as a bootblack—with great luster, but his name sat on him, like a monster on a mouse, and the like result followed. I thought of this as I set down the name of an instrument which has been shown me; but as it so much more fully describes it than the name by which it was called—"a

section liner"—I have used it at all risks and hazards. I am altogether unacquainted with the use of such tools, but it appears as though, with some simple arrangement affixed to it to extend its field of operations after it has gone its length, it may perhaps very well serve the purpose of its design. I send a drawing of it to you for publication, if you think it worthy of consideration. There is certainly one thing about it which, at this time, seems commendable, and that is the simplicity which will enable it to be cheaply manufactured and sold, provided those who use instruments for its purpose think it is advisable to make it at all. The distance separating the lines drawn by it may be varied at will from nothing up to an eighth of an inch. At one setting of a five-inch slide-rack it will lay out lines on any space from five inches down, according to their fineness. By attaching a straight-edge to the ruler, its length may be extended to any amount desired. Any irregular form attached to it, in the proper position, will guide parallel lines $\frac{1}{8}$" apart, and by resetting the plate, lines may be made to any degree of closeness to each other. Of course it is not claimed that curves which are parts of circles of equal radius can be drawn with it parallel to each other in any part. The illustration shows two different effects in the dotted lines of the adjustment of templates for drawing irregular lines.

The description of the tool is as follows: *A* is the frame, made of two plates, the lower one of which is plain, and the upper one struck up into the shape shown in the side view. Fig. 2 forming a groove in which the rack-slide *B* is moved by the simple mechanism shown, of which *C* is the "lever," *D* the "pawl," and *E* the "catch spring." *F* is the "ruler," which is pivoted on the "thumb screw" *G*. When it is closed down, as seen in Fig. 1, the movement of the rack-slide will make no change in lines drawn along its edge; but when it is turned to stand perpendicularly to the frame, the lines drawn along by its edge, when the rack is moved a tooth at a time, will be separated from each other by a distance equal to the pitch of teeth, say one-eighth of an inch. The ruler is marked in equal divisions, and may be set by means of the larger quadrant—shown on the dotted ruler—to the proper angle to draw any number of lines to the inch, the right-hand side of the quadrant being set at the number desired, and the periphery of the quadrant resting on the frame, as shown in the cut. The ruler indicated by the dotted lines is set, as will be observed, to make $11\frac{1}{2}$ spaces to the inch. When set by the smaller quadrant, the ruler makes twice the number of spaces indicated by the scale; for instance, it is shown in the cut set at $5\frac{3}{4}$, and the ruler will make $11\frac{1}{2}$ spaces to the inch, as already stated. This feature makes the ruler convenient to lay out scales for measurement in scaling down drawings, or for any other purpose, as they can be accurately laid out by it without any other measurement except setting the ruler, while with any other instrument of cheap design it would be troublesome to lay out, say $13\frac{3}{4}$ equal spaces to the inch. On the one which was shown to me the quadrants slide in a groove in the ruler; but, as this adds to the expense, they may be made to the shape of which the side view is shown at the end of the dotted ruler.

When the rack is fed out it will protrude from the frame, on the left-hand side, about one-half of its length, and it may then be returned to its starting place, protruding half its length on the right-hand side, by inserting a point in the slot *H*, above the catch spring, and moving it to the left, which will raise the catch spring and pawl from the rack, and hold them until the rack is moved back, and, the point being withdrawn, they will again drop into place. By changing the thumb-screw to the right-hand end of the ruler the lines will follow each other down; each line will be lower than the previous one. As shown in the cut, the ruler hinged on the left-hand side; they will follow each other up. This instrument can be well made of German silver plate at little expense. The key *I* is conveniently placed to be moved with a slight motion of a finger of the left hand, which rests easily upon the frame. Remarks are in order, and will be carefully considered by TYRO.

[This instrument, if correctly made, will undoubtedly be very useful for many purposes. The construction of its scale involves certain geometrical principles which we shall now examine more closely, as these may be applied to the construction of other mechanism.

Let *c b* (Fig. 3) represent the edge against which the arc of the quadrant *d f g* rests; 1*r*, 2*r*, 3*r*, etc., the pitch of teeth on the rack; *c a* the edge along which the lines 1*a*, 2*a*, etc., are drawn; and the divisions 1, 2, 3, etc., on the line *c a*, the scale to which the quadrant is set. The divisions on the line *c a* are equal to the pitch of the teeth on the line *c b*; the divisions on the line *c a*, and also the pitch on *c b*, are laid off from the point *c*, in which the lines *c a* and *c b* intersect each other; the point *c* represents the center about which the line *c a* turns. It is to be proved that the line *d g* will contain as many lines 1*a*, 2*a*, etc., as the number of divisions on *c a* to which the line *d g* has been set.

Let us first look at this problem in a practical light. Suppose that a

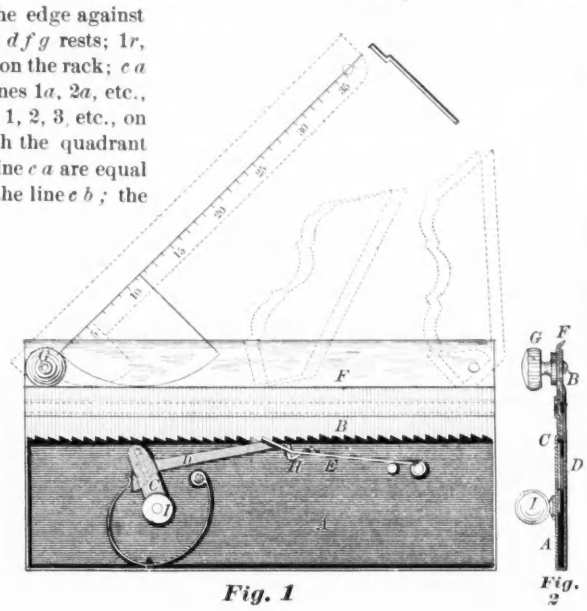


Fig. 1

Fig. 2

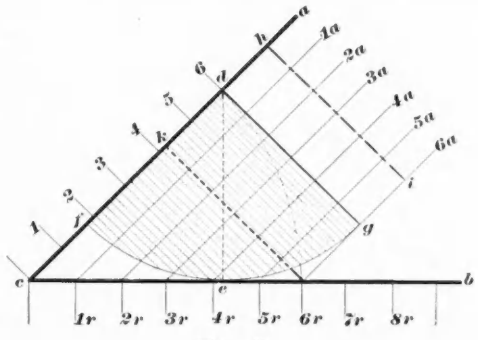


Fig. 3

ADJUSTABLE PARALLEL RULER.

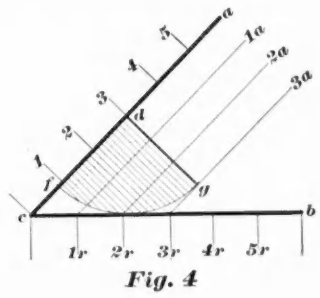
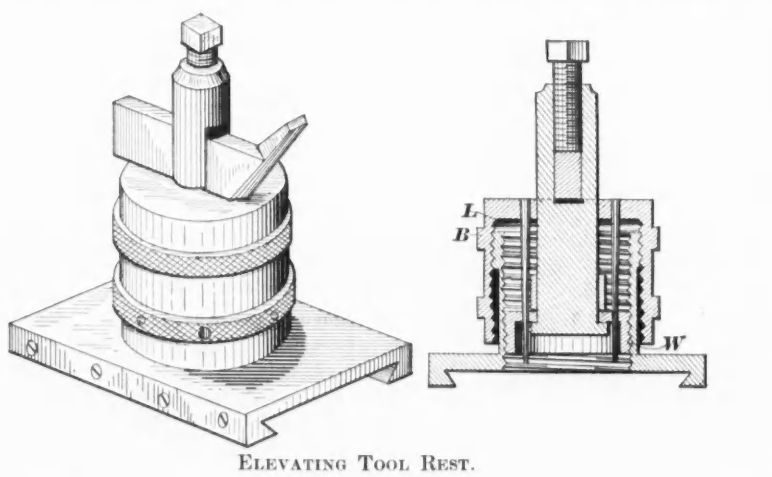


Fig. 4

number of lines 1*a*, 2*a*, etc., parallel to *c a*, have been drawn with the instrument; it is now required to find the number of these lines which will pass through a space one inch wide. The practical man will naturally draw a line *h i* one inch long perpendicular to *c a*, and then count the number of lines passing through *h i*; in this particular case he finds that there are just six lines passing through *h i*, and thus completes his problem.

Now, instead of drawing the line *h i*, we can accomplish the same thing with a circular sector whose radii are perpendicular to each other. Let the shaded portion *d g f* (Fig. 3) represent such a sector, and let the radii be just one inch long. Holding the radius *d f* against the edge *c a*, we may count the number of lines passing through the radius *d g*. Now assume that the sector is moved along the edge *c a* until the arc of the sector touches the line *c b*; in this position we can still count the lines passing through *d g*, and the number of these lines must be exactly equal to the number of teeth or divisions between *c* and 6*r*, because all the lines through the divisions 1*r*, 2*r*, etc., are parallel, and the line through 6*r* passes through the extremity *g* of the line *d g*. The arc *f e g* touches the line *c b* in the point *e*; this point will lie in a line *d e* drawn through *d* and perpendicular to *c b*. The line *d e* must be equal to *d g*, because both are radii of the same arc. Through the point 6*r*, in which the line 6*a* cuts *c b*, draw a line 6*r k* parallel to *d g*; the line 6*r k* will be equal to *d g*, and consequently 6*r k* must also be equal to *e d*, because both are equal to the same line



ELEVATING TOOL REST.

d g. Now, since 6*r k* is equal to *d e*, it follows that the right-angled triangle 6*r k c* must be equal to the right-angled triangle *e d c* in every respect, hence *c* 6*r* must be equal to *c d*; but the division on *c* 6*r* indicates the number of lines parallel to *c a* which pass through *d g*, hence if the divisions on the line *c a* are equal to those on *c b*, and the sector is set so that its arc will touch *c b*, then the number of divisions between the points *c* and *d* will indicate the number of lines passing through *d g*, which was to be proved.

If the quadrant or sector is smaller than that shown in Fig. 3 (say the radii of the sector are only half of an inch long as shown in Fig. 2), then the index on the line *c a* indicates the number of lines contained in a space half of an inch wide. In Fig. 4, for instance, the instrument indicates that there are three lines or three spaces to the half inch, or $3 \times 2 = 6$ lines to the inch, and agrees with the description of the instrument.]

Some Queries.

Editor American Machinist:

I am interested in the different views of your correspondents on the emery wheel and grindstone question. I have not had any experience with emery wheel tool grinders, and therefore cannot say whether they are any better than the much-abused grindstone. But I think if you have a grindstone of the right grit, run at a good speed, and *kept true*, the old-time grindstone would not be condemned as often as it is.

I would like your readers to give their experience with the different machines that are in the market for keeping grindstones true. Also what success they have had with self-hardening steel; do they get any better results than with common tool steel?

JOHN T. DAVIES.

Elevating Tool Rest.

The accompanying engravings represent in perspective and section a new elevating tool rest for lathes, which has recently been patented by Mr. Wm. L. Ramsey, of 101 W. Fifth avenue, Knoxville, Tenn.

The base piece in this rest is made in the usual form, and is fitted to the cross-slide in the usual manner. The upward extension of this piece, however, is cylindrical, and is threaded internally from top to bottom, as shown. Outside it has a short thread near the top only. The outer shell *B*, upon which the tool rests, is threaded internally to fit this short thread, so that, by rotating *B* by means of the knurled collars, it is raised or lowered. Fitted to the internal thread of the base piece is a short piece *W*, through which the tool post passes, and in which it turns freely, so the tool can be put in any desired position. This piece *W* is made to turn with *B* by means of the two pins shown passing down from one to the other; and, all threads being of the same pitch, it is evident that the relative heights of *B* and *W* will be maintained, and that when the tool post screw is tightened on a tool, the strain upon *B* is downwards, while that upon *W* is upwards, the two forces balancing and locking the device by frictional resistance.

It is thus seen that, when the tool post screw is loose, the height of the tool is easily adjusted by simply turning *B*, and, when adjusted, tightening the tool locks the rest.

The parts are thoroughly protected from dust and chips, while at the same time the rest can be taken apart very readily for cleaning or inspection. It also has the advantage of simplicity of construction, though the necessity for loosening and consequently disturbing the position of a tool, in order to raise or lower it, might, in the case of threading and some other tools, be objected to by some. This, however, is far better than having to loosen the tool and insert or take out washers, nails, etc., to get the proper height, and the tool always rests fair and square on its seat, and the screw always has a square bearing on the tool.

A correspondent sends us a newspaper clipping (without name of paper) that details some of the troubles of railroading on the Central Pacific. One of the officials of the road is reported as saying:

"We went down to Colfax for that train twice with a snow-plow outfit," said Mr. Fillmore, "but were afraid to go ahead with it, and both times went back without it. The plow went down the third time on Wednesday, and finally they started. There was a snow-plow with nine engines behind it first, five engines on the train of nine cars, and behind it came five engines with a gang of men to dig them out if they got stuck and take the train back—nineteen big engines taking one train through. The whole situation was enough to make a fellow's hair turn grey. We would climb out on the snow-sheds, with the storm howling and snow everywhere, and strain our ears for a whistle or a rumble that would show that something was not stuck and was coming. In the morning we would cut a hole down to the window of the telegraph office to let in some light. It was an immense relief when the storm let up and the danger was over."

It will be concluded that railroading over the mountains is not all fun—that is, railroading in the winter months.

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The Lake Shore Accident.

The fatal accident which occurred on the Lake Shore road on the night of March 6, must, we think, be classed among those which are unnecessary, and which ordinary care and prudence on the part of the trainmen would have avoided. The accident also shows how easy it may be for a thing, the chief object of which is to insure safety, to become, by neglect or abuse, a positive source of danger. The great feature of the automatic air-brake, and the one which more than anything else gives it its superiority over the old hand-brakes, is the fact that it is so arranged that, when given any kind of decent care and attention, it will infallibly prevent such accidents as this. With this care and attention it is the greatest safeguard against accidents ever introduced into railroading; but without it, the brake becomes simply an additional source of danger, as was conclusively shown in this accident, which in all probability would not have occurred had the train been equipped with nothing more the old-fashioned hand-brakes.

Trainmen, like other people, naturally adapt themselves to circumstances. Brakemen employed on passenger trains in days gone by were real *brakemen;* were trained to rely upon the brake, were familiar with it, and skilled in its use. The term "brakemen," as applied to passenger trainmen on any of the first-class roads of the present time, is a misnomer. The engineer is the brakeman, and the men who are called brakemen must, in the nature of things, be very inefficient as compared with those who were accustomed to the constant use of hand-brakes, and knew that the only dependence for stopping in case of emergency was in them, supplemented, perhaps, by reversal of the engine.

The trainman who in this instance discovered that the rear portion of the train he was on had become detached, and was rushing down grade, knew at once that it was his duty to stop the cars. Had he been accustomed to the daily use of hand-brakes, he would in all probability have applied them at once and averted the accident; but, accustomed as he was to trains equipped with air-brakes, his first thought seems to have been of them, and he spent the time in going through the cars, and trying in one after the other to apply the brakes, though it was previously known that they were not in proper working condition. Had he been thoroughly familiar with them he would have been satisfied, after trying the first car, that the brakes were not available, and would have lost no further time in trying other cars, but would have applied the brakes by hand at once.

The train should have been automatically stopped by the action of the brakes, and no passenger train should in these days be run in such a condition that it will not be instantly stopped as soon as any part of it becomes detached.

That such a road as the Lake Shore is liable to run trains in such condition will be a revelation to many, and may well cause us to inquire upon what road we may travel in order to be sure that all modern appliances for securing safety are not merely adopted and in nominal use by the road, but in full use at all times, and on any train we may happen to take.

The subject of the accident has been treated by many of the papers as if it were supposed that accidents were not unwelcome to railroad companies, which, of course, is not true, as it is to their interest in every way to prevent them so far as possible; but it is true that the public and the companies look at the matter from entirely different standpoints, the public considering the lives endangered or destroyed, while the companies consider little besides the comparative cost of accidents on the one hand, and the prevention of accidents on the other.

Not much information upon which a theory of the cause of the accident can be based, has leaked out of the barricade erected by the Lake Shore officials; but it seems probable that the primary cause was that different kinds of couplers came together on the sleepers, and, not coupling very well, caused the breakages, one of which occurred previous to the fatal break. In any event, the brake which the trainmen had become accustomed to depending upon, by unfair treatment failed just when it was most needed. For this unfair treatment some one is responsible, and just whom it may be it is to be hoped will be discovered.

One thing may be said in this connection, however, and that is, that, had any delay taken place by reason of stopping to make things all secure, it is probable that much complaint would have been heard from the passengers. The traveling public are impatient of delays, and safety sometimes involves delay.

If any one doubts that the great cantilever bridge across the Firth of Forth in Scotland has been triumphantly finished and opened for traffic, he has only to glance at our leading English contemporaries to have his doubts removed.

Engineering has a descriptive article filling 70 of its large pages, and giving illustrations of every thing about the bridge or connected with it, even of the machinery used in its construction, alternative designs, which were submitted, etc.

The history of the bridge is given, and nothing which any one can possibly desire to know regarding it seems to have been omitted. In addition, there are 20 large double page plates, giving views of the bridge at different stages of its construction, and of the prominent men connected with it.

Industries is scarcely behind its contemporary, and issues a superb number in honor of the event.

The Firth bridge is the world's greatest piece of engineering work; its opening was a great occasion, and our English engineering contemporaries have proven themselves fully equal to it. For the convenience of our readers, many of whom will doubtless wish to obtain and preserve copies of these papers, we will say that *Industries* can be obtained by addressing *Industries*, 358 Strand, W. C., London; the price of this special number being one shilling, or 25 cents. *Engineering* can be obtained of the American agent, Wm. H. Wiley, 53 East 10th street, New York City. We are not informed regarding the price.

Angus Sinclair, editor of the *National Car and Locomotive Builder*, has been connected with the making of some experiments with the compound locomotive on the Michigan Southern Railroad. He finds that this locomotive, on the work that it was doing—which was presumably the kind of work it was best adapted for—proved itself superior in point of fuel consumption to the simple cylinder engine that was put into the test against it.

Mr. Sinclair's conclusions lead to the belief that if a locomotive, like a mill engine, for example, could be designed for certain work, practically unvarying, there would be considerable advantage gained by compounding. Undoubtedly many locomotives on large roads can be so used. But many, especially on small roads, cannot. In instances where locomotives must be used for all-around purposes, or where the duty on runs is quite variable, the economy of compounding is doubtful.

In Scotland, recently, four workmen in a locomotive works were fined in the "Small Debt Court," before Sheriff Lees, for being absent from their work without leave. The sheriff, in deciding, said the rules of the works were binding, and men must know that they could not come and go as suited themselves only.

Literary Notes.

A HANDBOOK OF ENGINE AND BOILER TRIALS, AND OF THE INDICATOR AND PRONY BRAKE. For Engineers and Technical Schools. By R. H. Thurston, M. A., LL. D., Dr. Eng'g. New York: John Wiley & Sons. Price, $5.

The records of engine and boiler tests have almost invariably in the past been, if not worthless, at least defective in some important particulars. Heat is one of the most elusive things with which the engineer has to do, and the test of a steam plant that shall give within reasonable limits of accuracy the distribution of the heat generated in the furnaces of the boilers will always tax the skill of the engineer to make. So much unsatisfactory work has been done in this direction that owners have come to have little faith in expert tests, and many engineers seriously discredit them. In engine and boiler tests not only is the greatest care essential, but it is just about equally necessary that the one making the test should know what he ought to determine from it.

Dr. Thurston in this book gives the student an account of what are considered by eminent engineers the best methods of testing engines and boilers, the appliances used in such tests, and the manner of arriving at conclusions. There are also examples of tests actually made. All the tables required in working up the results of tests are given, together with a great deal of incidental information. Those desirous of perfecting themselves in testing engines and boilers will find a great help in this book.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(107) L. W. F., Tiffin, O., writes: Please let me know how to cement rubber to iron. *A.*—The following is recommended: Soak pulverized gum shellac in ten times its weight of strong ammonia. This will make a slimy mass, which, if left to stand for a few days, will become liquid, and ready for use.

(108) C. M., Brooklyn, N. Y., asks: 1. Would you advise me to serve an apprenticeship to learn the machinists' trade? *A.*—Yes, if you want to become a machinist. 2. How many years must I bind myself for? *A.*—In this country three years is the custom—sometimes four. 3. What are the wages for an apprentice? *A.*—Wages are different in different shops. 4. Must I sign a contract? *A.*—You ought to. Some shops do not require it. 5. Can I learn the trade by going from one shop to another? *A.*—No.

(109) T. D., Tiffin, Ohio, asks: Will you please tell me of something that will case-harden machinery steel, say about $\frac{1}{64}$ or $\frac{1}{32}$ inch deep? I have tried carbonate of potassium and cyanide, but neither will act right. Also, is there anything I can use to harden set screws in small quantities? *A.*—If you want to harden the steel to the depth mentioned, you must put it through the regular case hardening operation, *i. e.*, pack it in bone charcoal and heat it. Set-screws, to be hardened properly, must be done in the same way, as a mere hardening of the thin outer surface does little if any good.

(110) "F.," Rochester, N. Y., asks: 1. Which is the best oil to use on belts? *A.*—We cannot say; but you can procure a very good oil for the purpose, of the belt manufacturers. 2. Which is heavier, a pound troy weight or a pound avoirdupois, and how do the ounces compare? *A.*—One pound avoirdupois equals 1.2153 pounds troy, 480 grains troy equals one ounce troy, and 437.5 grains troy equal 1 ounce avoirdupois. 3. Is soda mixed with water for use on machine tools to prevent rust, and how is it mixed? *A.*—It is so used, and is mixed by simply throwing it into the water and letting it dissolve.

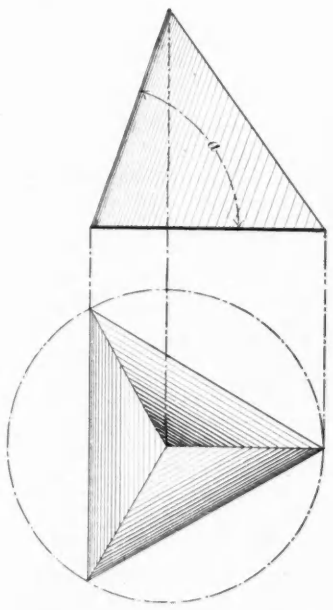
(111) "Reader," Philadelphia, asks: Will you kindly inform me how many shots a Gatling gun will fire per minute, and how long it can be kept up without the barrels heating? Has the gun more than one barrel, and would it be as handy to handle in battles on land, as the ordinary old-style cannon? *A.*—Gatling guns are made with five or ten barrels; the former being capable of 800 shots per minute, the latter of 1,000 per minute. They are, we believe, as convenient to handle as any cannon of the same weight, whether on land or sea. But a Gatling gun and a cannon of the same weight would not ordinarily be used for the same purpose.

(112) W. B., Philadelphia, writes: In our shop we are required to soften the ends of hardened and tempered steel rods of $\frac{1}{8}$ inch diameter, for a distance of say 1 inch. In doing the work in our way great injury at times is done to the goods by reason of the heat running up and making the rods very soft for over two inches. The reason we soften the ends is to make subsequent operations easier. What would you advise as to the best way

of doing this work? *A.*—We should heat the ends in a lead bath kept considerably hotter than would otherwise be necessary, so that the heating would be done very quickly. Then put them in warm water, letting the heated ends project above its surface, but letting the surface of the water nearly reach the heated portion. A few trials will show you just how far up you should heat them, and how close the surface of the water should come, to get the desired effect.

(113) J. R. A., Charlotte, N. C., writes: I want to cast a steel face on hammer dies for a steam hammer so that the steel will stick. How is it done? *A.*—The principle involved, of uniting steel to cast-iron, is similar to that which foundry. men call "burning," and therefore the strength of the union will depend greatly upon the shape to be united, and on the plan adopted for uniting the pieces. One method is to lay the steel in the mould and close it firmly. The cast-iron is then poured in a steady small stream into the mould, allowing part of the metal to overflow through a small outlet. When about 75 per cent. of the mould is filled, slacken the pouring so as to have but a small stream, at which time the overflow or outlet must be quickly and reliably stopped. After this quicken the pouring until the mould is filled up. To do this successfully, good judgment and experience are called for.

(114) "Reader," ———, writes: We have been having some trouble in shrinking on wrought-iron saw arbor collars, and we would like to know the amount of shrinkage to allow on such collars with holes from 1½ to 3 inches. Have been allowing $\frac{1}{32}$ inch on collars with 2½-inch hole Is this correct? *A.*—It is too much. You do not say what the nature of your difficulty is, but we presume that, if you allow that much for shrinkage, you either have trouble in getting them on the shaft, or they burst after they are on. About .003 inch per inch of diameter of hole is plenty for such work, and for cast collars somewhat less, say about .002 inch per inch of diameter. Do not heat the collars quite red-hot. A very good rule is to bore and turn the work as you would for a tight driving fit; then heat the collar moderately—not red-hot—and put it in place immediately, cooling it with water. It will be tighter than if driven on with the same allowance.



(115) I. S. M., Baltimore, Md., writes: Please give size of angle between two adjacent sides of a tetrahedron. *A.*—The angle *a* between two adjacent sides of tetrahedron, as shown in the figure, will contain 70 degrees, 32 minutes nearly.

(116) A. A. F., Carlinville, Ill., asks: 1. What are the small holes in the sides of brass cup valves of pumps for? *A.*—If you had given the maker's name of the pump we could have answered your question. Under the circumstances we are compelled to advise you to write to the makers of the pump for the desired information. 2. Is it advisable to take the heads off the rivets on boiler sheets for repairs with the sledge and steel bar? *A.*—It is customary to do so, and, when care is exercised, it is as good a way as any other. 3. Does the tool revolve around a pin of a crosshead pin in turning it in the lathe? *A.*—In lathes the tool is stationary. But there are special machines in which the tool revolves about the pin, and is used in cases where the crosshead and pin are cast in one piece. 4. How large should a steam pipe be for a cylinder 7½x12? *A.*—The size of steam pipe depends on the piston speed. The rule is: Multiply the piston speed per minute by the decimal .08, and divide the product by 600; the quotient will be the ratio of the cross-sectional area of the steam pipe to that of the piston. Multiply this quotient by the area of the piston; the product will be the cross-sectional area of the steam pipe. Thus, say the engine is to make 250 revolutions per minute, the piston speed will then be 500 feet per minute.

$$\frac{500 \times .08}{600} = .066.$$

The area of the piston is 44.17 square inches; hence $44.17 \times .066 = 2.91$ square inches for the cross-sectional area of the steam pipe. The corresponding diameter will be two inches nearly.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue.

Link-Belting and Sprocket Wheels.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link-Belt Engineering Co., Philadelphia and N.Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Graduating Machines. A. T. Koopman, Chicago.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co, Syracuse, N. Y.

Drop Presses, Punches and Shears. Williams, White & Co., Moline, Ill., manufacturers.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Davis Key-Seating machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

Ice and Refrigerating Machines, 140 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

"How to Keep Boilers Clean." A 96-page book mailed free by Jas. E. Hotchkiss, 120 Liberty st., N.Y.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Castings for small and medium-sized vertical engines. Humphrey's Foundry, Bellefontaine, Ohio.

Locomotive Driving-Box Planer Tool. Pedrick & Ayer, Philadelphia, Pa.

Special Tools for Railway Repair Shops. Pedrick & Ayer, Philadelphia, Pa.

Whiton's Chucks. S. A. Smith, 23 S. Canal st., Chicago, Western Representative.

Light Special Machinery and Tools to order. The Meriden Machine Tool Co., Meriden, Conn.

For the latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Send $1 for Catalogue D, Fine Tools and Supplies. Over 550 pages. Fully illust'd. Free when $10 worth goods are ordered. Frasse & Co., 92 Park Row, N. Y.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Split Pulleys at low prices and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

Patent Attorney. R G. DuBois, 715 11th st., Washington, D. C., procures first-class patents on inventions. Valuable Hand-book on patents free.

S. W. Card & Co., Mansfield, Mass., make everything in the line of Taps and Dies. S. A. Smith, 23 S. Canal st., Chicago, Western Agent.

The Sure Grip Steel Tackle Blocks must fill the bill, according to the large sales reported. See advertisement, page 13.

Watch this column for our Weekly Announcement of Bargains. Selling Overstock. McFadden Co., 1,025 Market st., Philadelphia, Pa.

Patents.—Patent soliciting of high class.
D. Walter Brown, 31 Nassau st., New York.
Send for "A Brief History of Patent Legislation in the United States."

25" 28" 32" 36" Upright Drills a specialty. Finely made, great capacity, quickly operated, prices low. Send for list of firms using our Drills. J. E. Snyder, Worcester, Mass.

25" 32" 37" 42" "Only Drill Press built on 'Ko-rekt' principles, even if they come from Jersey." Gould & Eberhardt, New Ark, N J.

The Lexington Gear Works, of Lexington, Mass., have issued a Catalogue of some six hundred sizes of Cut Iron Spur and Bevel Gear Wheels. Every machine or manufacturing concern in the country should send for a copy.

Every draftsman needs one. The Engineer's Sketch Book of mechanical movements, appliances, devices, contrivances, etc., by T. W. Barber. 1,936 illustrations. 8vo. cloth, $3. Catalogue of books on mech. subjects free. E. & F. N. Spon, 12 Cortlandt st., New York.

Superintendents of industrial establishments will find the *Engineering and Building Record*, published weekly at 277 Pearl st., New York, useful. Municipal and building engineering problems a prominent feature. Specimen Copy, 10 cents.

De Lamater Screw Propeller Wheel made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

Stub Ends and Connecting Rods for small connections. Especially adapted for Valve Rod for Steam Engines.
T. C. Dill Machine Co.,
Philadelphia, Pa.

T. R. Almond wishes to form a company for the manufacture of his patent angular coupling, or to make arrangements, either by sale of patents outright or otherwise, whereby this valuable invention may be properly placed upon the market. Address T. R. Almond, 83 and 85 Washington st., Brooklyn, N. Y.

Just concluded. "Practical Drawing." By J. G. A. Meyer. Copies of the American Machinist containing the above series of 93 articles sent by mail to any address in the U. S., Canada or Mexico, for $4.65, or single copies 5 cents each. American Machinist Publishing Co., 96 Fulton st., New York.

We were badly damaged by fire on the night of March 4, but, owing to our excellent system of water-works, were enabled to save a part of our machinery, and have moved same into our basement, and are now ready to fill orders as usual. We also saved a large part of our stock. S. W. Card & Co., Mansfield, Mass.

H. B. Roelker, 22 Cortlandt st., New York, late Sup't De Lamater Iron Works, will hereafter manufacture the De Lamater Screw Propeller. Propellers of same pattern and workmanship as formerly made by the De Lamater Iron Works. Each designed for its special work at lowest prices. Consulting Expert and Constructing Engineer. Estimates made on machinery and on damages.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 53 East 10th st., New York.

"Binders" for the American Machinist. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton st, New York.

Just concluded. "Modern Locomotive Construction." By J. G. A. Meyer. The above series of 106 articles, which have attracted so much attention everywhere, is now concluded in newspaper form. Copies of the American Machinist containing the entire set sent by mail to any address in the U. S., Canada or Mexico for $5.30, or single copies 5 cents each. American Machinist Publishing Co., 96 Fulton st., New York.

MANUFACTURES

C. M. Wheatley will build a foundry and machine shop at Americus, Ga.

Golden Brothers will build a foundry and machine shop at Columbus, Ga.

Camp Brothers will rebuild their saw-mill recently burned at Campville, Fla.

Ground has been broken for the large cotton mill to be built at Dennison, Tex.

The Peace River Phosphate Company will build a machine shop at Arcadia, Fla.

The Texarkana (Texas) Car and Foundry Co. will put new machinery in its foundry and machine shops.

Cole, Simkins & Co., of Brunswick, Ga., are forming a company to build a $35,000 cotton compress in Quitman, Ga.

A new company, known as the Mt. Kineo Woolen Co., has been organized, to operate the woolen mill at Sebec, Maine.

Mathews Bros., sash, doors and blinds, Belfast, Maine, owing to a large increase in business, will put in a new engine.

The Denison (Tex.) Iron Works is doubling capacity, and will be consolidated with the Washington Iron Works, of Sherman.

Parties are negotiating for the purchase of the Austin & Chandler shoe factory at Plymouth, N. H., with a view to starting a box factory.

The Standard Machinery Works, Bay City, Mich., have been running short time, but recent influx of orders is crowding them at full time now.

The Cordele (Ga.) Machine Shop has been incorporated by R. G. Tomlin, R. C. Harris, J. E. S. Shipp and others, with a capital stock of $15,000.

It is reported that a Kansas City (Mo.) company has secured a bonus of $20,000 and 5,000 acres of land to erect a 100-ton blast furnace at Queen City, Texas.

The Manchester (N. H.) Board of Trade has subscribed $23,000 to enlarge the shoe factory at East Manchester. It will be occupied by Kimball Brothers, of Lynn, Mass.

The Evans Friction Cone Co., Boston, Mass., manufacturers of frictional gearing, have issued an 1890 catalogue, with illustration and description of what they make.

Land has been bought in Portland, Maine, by James Harper, upon which to erect buildings for making lasts. He will put up two buildings, one 50x60 feet, and the other 30x60 feet.

The Denver (Col.) Natural Gas and Oil Co. has been chartered. The company holds long leases on more than 600,000 acres of land, and it is expected that work will be begun at once.

Alexander Zeck and others have incorporated the Grafton Foundry and Machine Company, to start a foundry and machine shop at Grafton, W. Va. The authorized capital stock is $25,000.

The Grimes Valve Gear Company has been incorporated in Chicago by Walter F. Render, Fred. S Stedman and A. I. Roberts. The company will manufacture the Grimes valve gear for locomotives.

There is water-works agitation at Bridgeport, Ala.; Camden, N. J.; Elmira, Iowa; Manchester, Iowa; Neosho, Mo.; Piedmont, Ala.; Ipswich, Mass.; St. Lambert, Can.; Lexington, Ky.; Sparta, Ky.; Franklin, Tenn.

A stock company lately organized to establish foundry and machine works at Tullahoma, has been incorporated as the Tullahoma Foundry and Machine Works, with H. Jacobs president, and J. H. Cordell secretary.

The Webster Woolen Company, Sebattus, Me., will build a large addition to its mill No. 1½ during the summer. The plant at present consists of eleven sets of cards and sixty-one broad looms running on fancy cassimeres and specialties.

The town of Lancaster, Ohio, expects to have a new organ factory, a rolling mill, a glass factory, and a foundry and machine shop amongst several other industrial establishments, all incident to the discovery of natural gas. The town offers free sites and free gas.

The N. O. Nelson Manufacturing Company are negotiating for an extensive manufacturing site at Edwardsville, Ill., to consist of over 200 acres. In case they secure the site, the Nelson Company will establish a large foundry, and various other manufacturing departments.

It is said that the agent of an English syndicate has completed the purchase of several farms at Lenover, Pa., for the purpose of erecting two mammoth cotton mills, and such a number of dwelling houses as will be required to accommodate the employes, whose number, it is said, will exceed two thousand.

An explosion occurred recently in the shaving or dust-room of the Armstrong furniture factory at Evansville, Ind., which utterly wrecked it, and then fire completed the work. Three boys were burned to death. Charles Shelby, the engineer, was blown twenty feet, and had both legs broken and his head badly crushed.

Arrangements are being made to form a new company to operate the Indian Orchard Mills at Springfield, Mass. The property is now owned by a syndicate, but a new company will probably be formed, and the No. 1 mill will, if the plans are perfected, be started within two months on the manufacture of yarn, with from 200 to 800 hands.

The Detroit (Mich.) Electrical Manufacturing Co. is the name of a new company, with a capital of $350,000. The company owns patents on storage batteries, and several other patents on electrical apparatus, and they will do a general business in manufacturing electrical machinery and supplies. The erection of works will begin without delay.

The business men of Ware, Mass., have decided to raise $10,000 at once for the general purchase and grading of land, and the erection of at least one building. A proposition was presented by a lathe manufacturer who now employs 31 men, who guaranteed, if a suitable building was provided, he would come to Ware and set 50 men at work within 90 days.

A bill has been introduced in the legislature at Richmond, Va., to incorporate the Richmond Equipment and Security Co., with W. H. Palmer, W. R. Trigg, J. J. Montague and others, as corporators, to co-operate with the Richmond Locomotive and Machine Works Co., the capital stock to be not less than $200,000 nor more than $3,000,000.

The St. Thomas Car Wheel Company, of St. Thomas, Ont., has been incorporated, with a capital stock of $250,000, to manufacture cast-iron and steel car wheels, iron and steel castings, to operate machine shop for the manufacture of all tools and equipments used in the operation of iron and steel foundries, and to operate foundries for the manufacture of iron, brass and composition castings, etc.

The board of directors of the St. Louis Railway Company, or Broadway line, have decided to cable the entire system from Wild Hunters to Bremen avenue, when the municipal assembly grants them the right to change their motive power—as it will do shortly, no doubt. The company has a capital stock of $1,000,000, and this will likely be increased by $1,500,000, in order to meet the cost of cabling. —*Age of Steel.*

The plant of the Knoxville (Tenn.) Woolen Mills is to be enlarged on an extensive scale. They will put in 300 new looms, 22 mules, and 10 sets of 60-inch cards. They will also add four boilers of 75 horse-power each, one 250 horse-power engine, and one of 75 horse-power. An incandescent dynamo of 500 lights capacity will be put into the mill. The company has a paid-up capital of $250,000, and has been running eight sets of 60-inch cards and 200 looms on all-wool jeans.

The machine shop of S. W. Card & Co., Mansfield, Mass., was recently damaged by fire to the extent of several thousand dollars. Immediately after the fire a large force of men were put to work oiling the stock of taps and dies, reamers and other small tools that had been wet, to preserve them from rusting. The basement of the building was fitted up at once and manufacturing begun, so that, with the stock on hand, the company is ready to fill orders without delay to customers.

The Crescent Iron Company has been organized by C. E. Shannon, James H. James, John G. Brown, John McKinley and Amos Shephard, all of Duluth, Minn., with a capital stock of $200,000. The general nature of the business is to buy, sell and lease iron lands, to mine and smelt iron ore, and to manufacture iron, steel, etc. For several months past the work of stripping and also sinking a shaft has been carried on under Captain Thomas James, and the indications are encouraging enough to warrant the expectation of shipments this season, provided the Iron Range road is extended from Ely, a distance of about five miles.

Jenkins Bros., 71 John street, New York, have issued a catalogue and price-list of valves, gauge cocks, the well-known "Jenkins" packing, and other specialties made by them. This price-list supersedes all others, and, as it differs materially from all others, should be in the hands of all users of these goods. It has been customary in the valve trade to quote very large discounts. This Jenkins Brothers think is detrimental to the trade, and they have reduced their price-list and lowered the discounts. A large variety of valves are illustrated in the catalogue, and there are illustrations of other of their products.

The new shops of the New York, Boston & Providence Railroad are to be fitted throughout with ball bearings on every line of shafting. The bearing is of a form devised by Mr. John J. Grant, manager of the Simonds Rolling Machine Co. This, it is thought, will be the first shop to be equipped with a line shaft having ball bearings. A company is in process of formation which will furnish ball bearings for all purposes, such as line shafts, car axle journals, thrust bearings, etc. It will be called the Simonds Ball Bearing Co., and it is understood that ex-Governor Howard, of Rhode Island, will be at the head of the enterprise.

Machinists' Supplies and Iron.

NEW YORK, March 15, 1890.

Iron—American Pig.—The tendency of prices is downwards. We quote standard brands No. 1 X Foundry, $19 to $20; No. 2, $18.25 to $18.50. Grey Forge, $17 to $17.50. Southern irons have sold at $18.50 to $19 for No. 1 X Foundry, and $18 to $18.25 for No. 2.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Wanted—First-class foundry foreman. Address B. W. Payne & Sons, Elmira, N. Y.

Wanted—Good machinery moulders. Steady work. The Am. F'dry and Mach. Co., Bowling Green, O.

Wanted—Good machinists; also a few exp'd scrapers. The Pond Machine Tool Co., Plainfield, N. J.

Wanted—Machinists, boiler makers and moulders; good general workmen. Address Frick Co., Waynesboro, Franklin Co., Pa.

Wanted—Experienced man to take charge of gang of hands in erecting medium heavy machine tools. Address Machine Tools, AMERICAN MACHINIST.

Wanted—Assistant draftsman. A young man with some experience. Apply to the Stiles & Parker Press Co., Middletown, Conn.

Wanted—By a reliable, thorough practical mechanic, position as manager, sup't, foreman or overseer. 20 years' exp. L. C., AM. MACHINIST.

Position wanted by a first-class mechanical draftsman, well up in general machinery designing. Address BOX 102, AMERICAN MACHINIST.

Wanted—Situation by a first-class pattern maker, 25 years' experience. Vicinity New York or Philadelphia preferred. BOX 103, AMERICAN MACHINIST.

Wanted—Ass't mechanical draftsman; a young German with technical education preferred. Good inducements to the right party. R. H. T., AM. MACH.

Wanted—Position as foreman of machine shop in the vicinity of N.Y. Exp'd in marine, stationary engines and gen'l machinery. Hustler, AM. MACH.

Wanted—Half a dozen first-class machinists on piece-work. Steady work, new tools, and liberal prices. Location, Western Pennsylvania. Apply to "W.," care AMERICAN MACHINIST.

Machinists Wanted—First-class vise and machine hands of good habits can find steady employment and liberal wages. Address Morgan Engineering Company, Alliance, Ohio.

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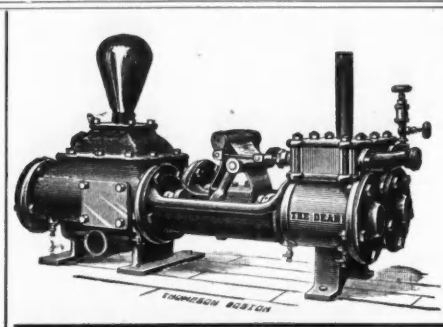

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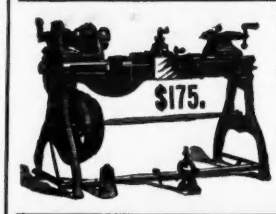

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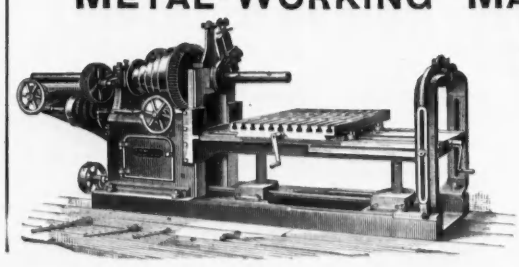

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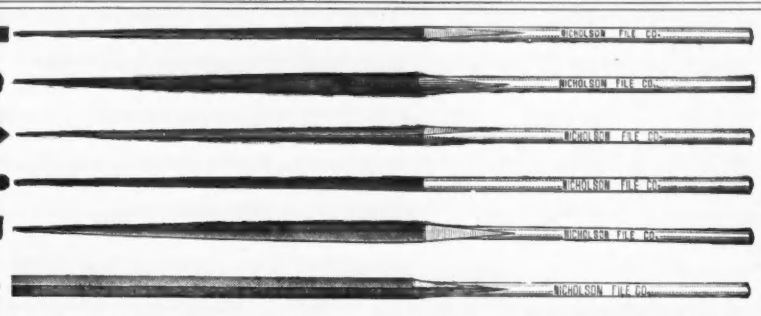

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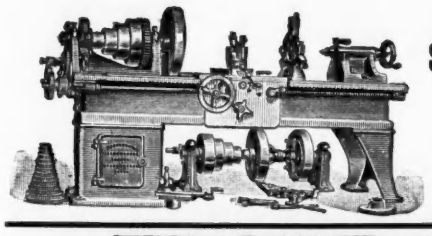

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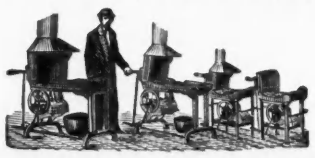

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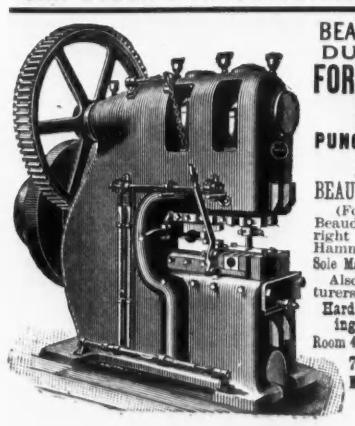

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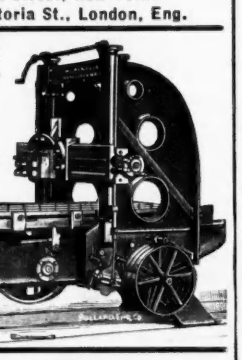

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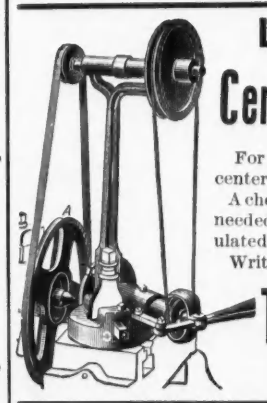

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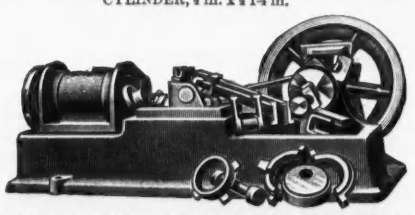

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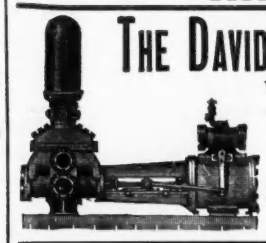

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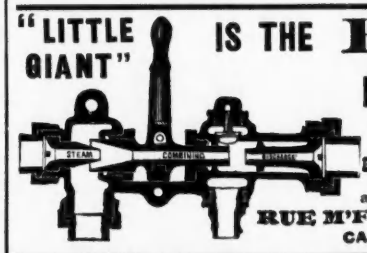

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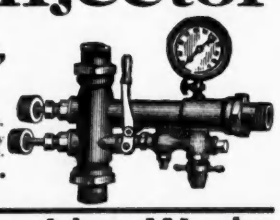

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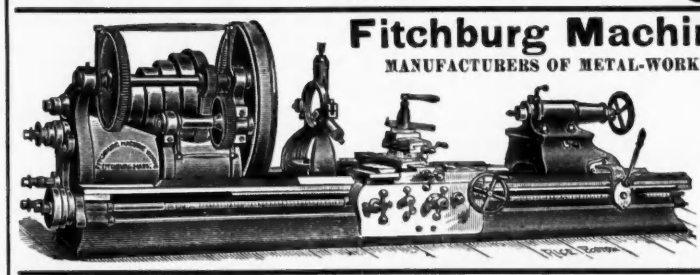

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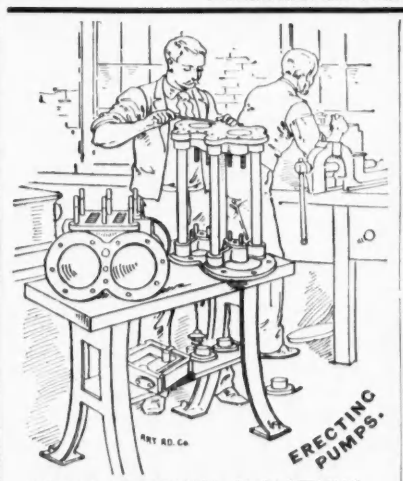

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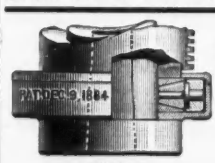

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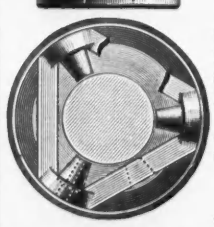

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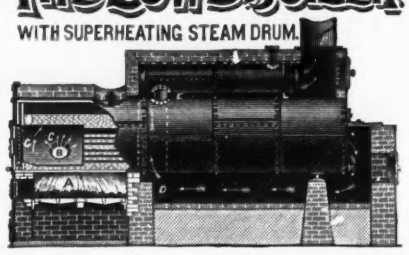

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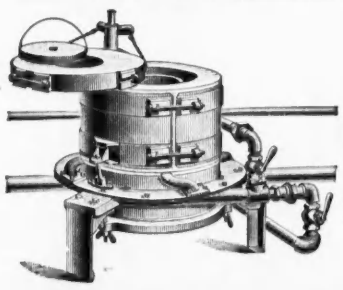

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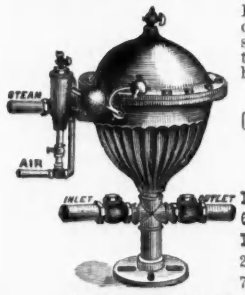

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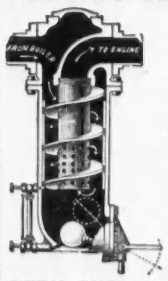

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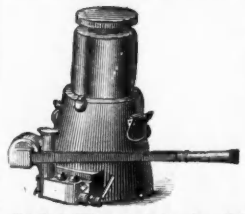

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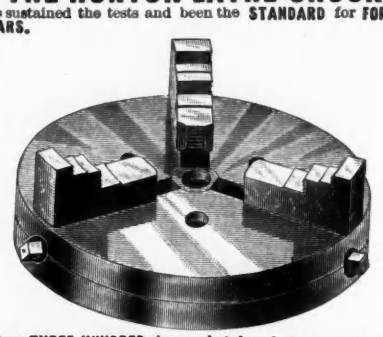

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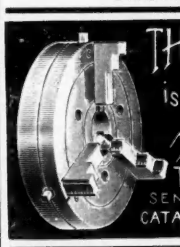

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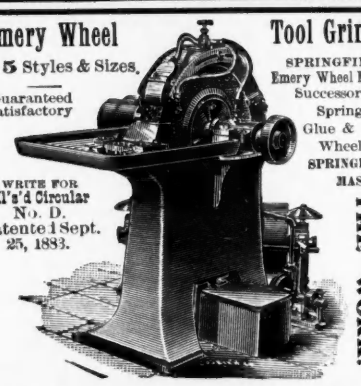

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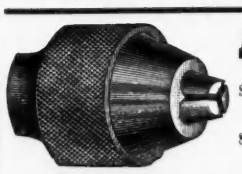

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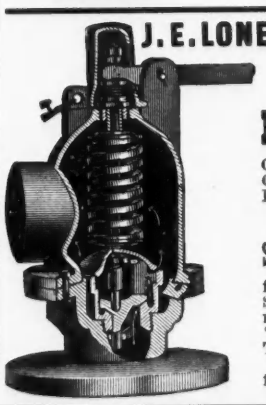

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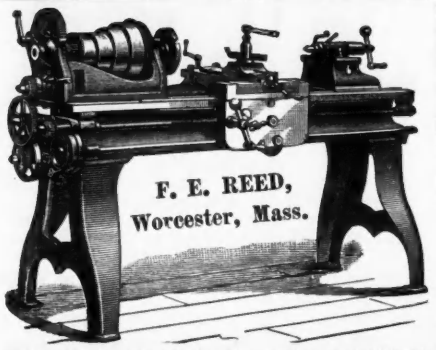

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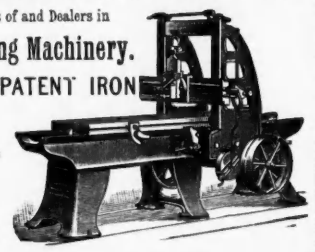

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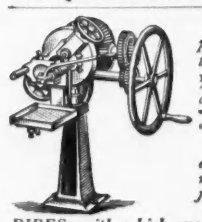

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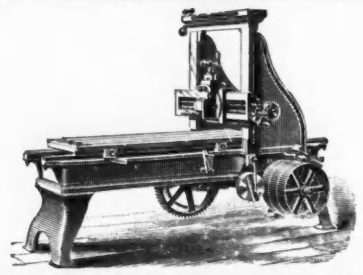

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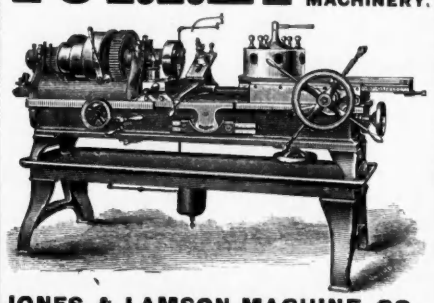

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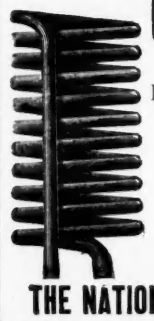

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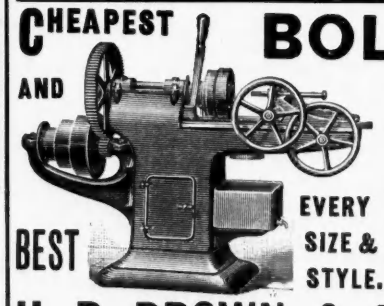

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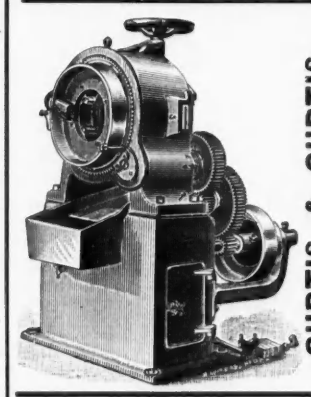

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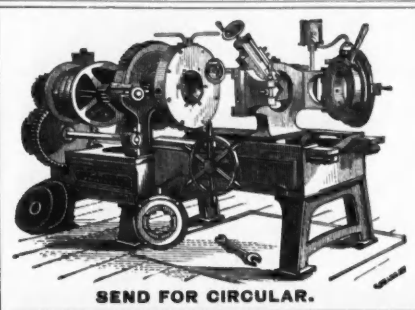

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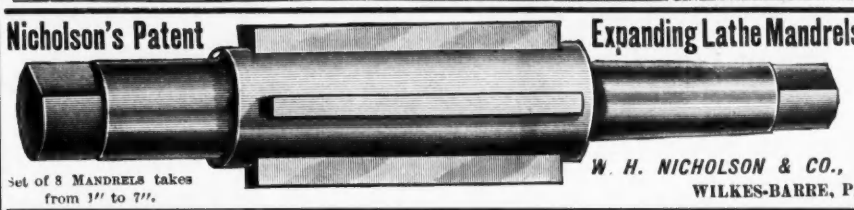

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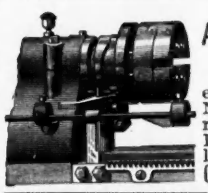

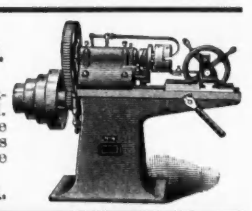

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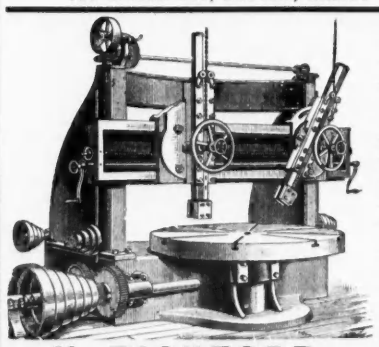

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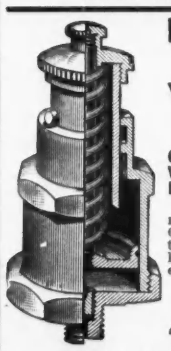

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Improved TURNTABLES for LOCOMOTIVES, CARS and PIVOT BRIDGES.
High Speed Power Traveling Cranes and Hand or Power Swing Cranes, Shafting, Pulleys, Hangers, &c., for transmission of power. Improved Self-Adjusting Injector of 1876. Self-Acting Injector of 1887. Fixed-Nozzle Automatic Injector of 1885.
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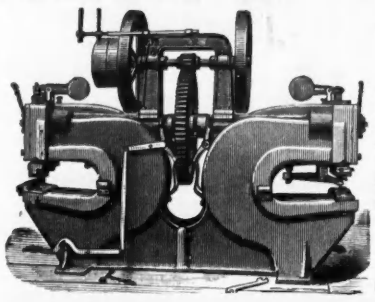

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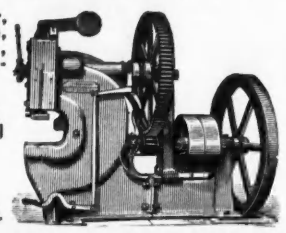

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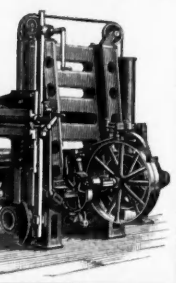

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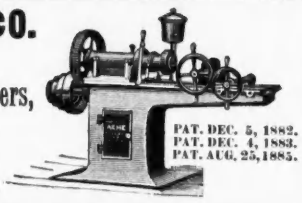

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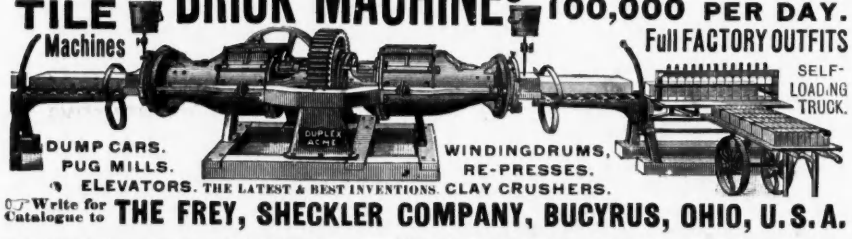

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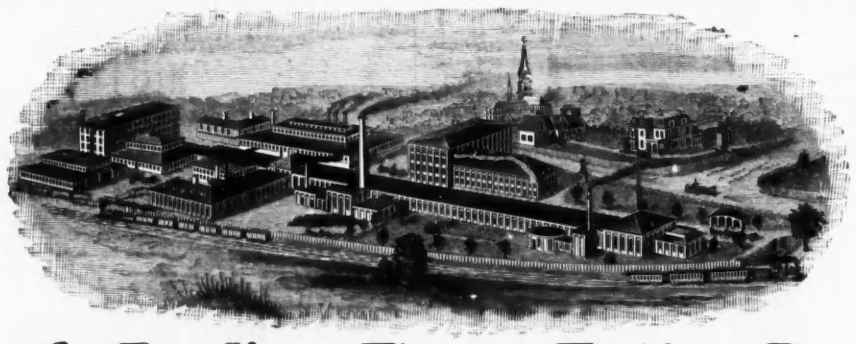

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DESIGNER & BUILDER OF THE FAMOUS
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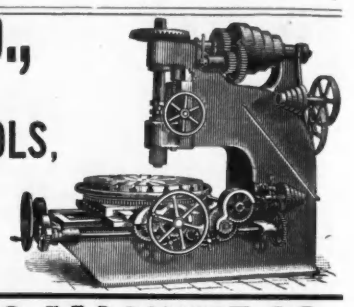

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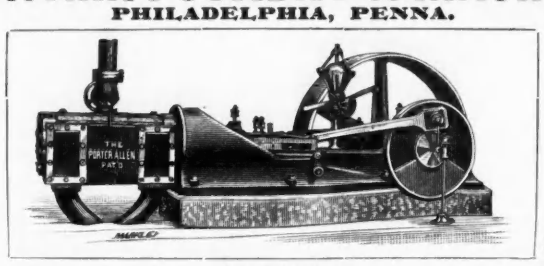

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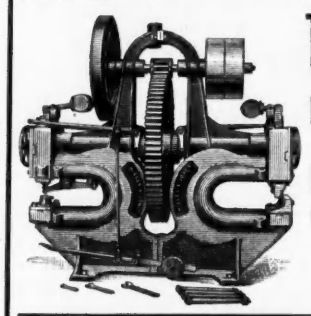

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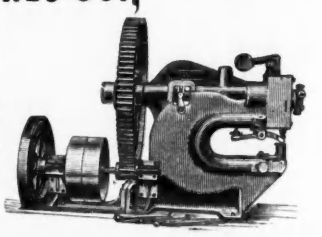

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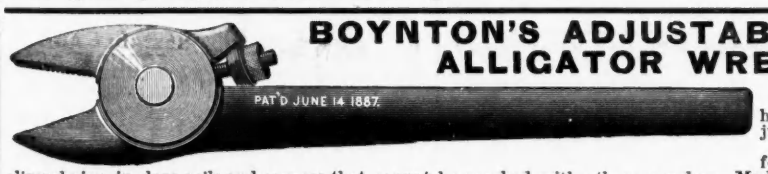

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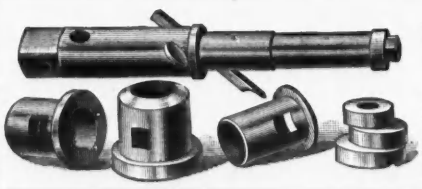

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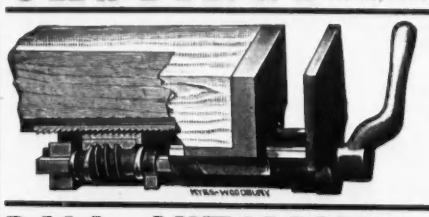

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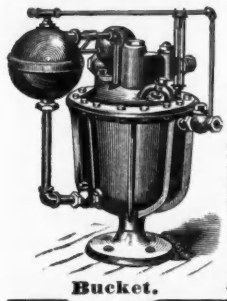

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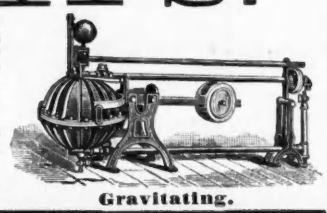

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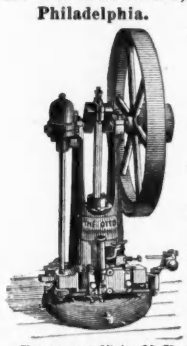

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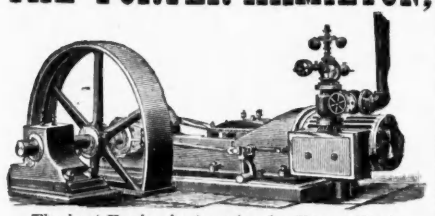

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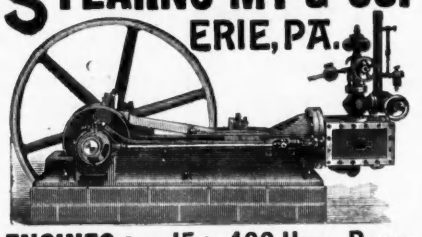

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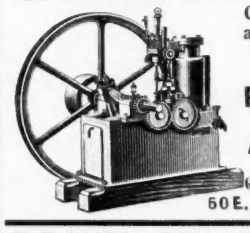

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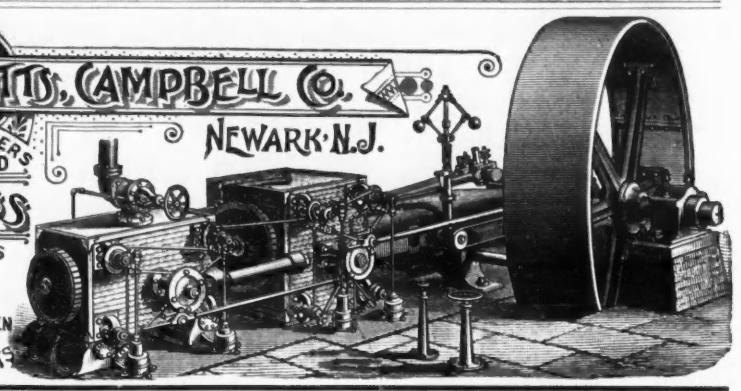

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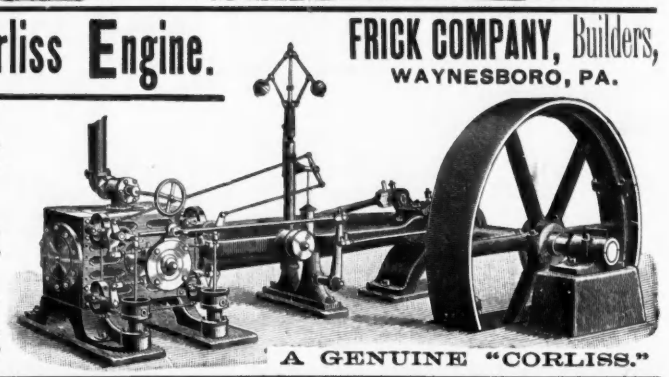

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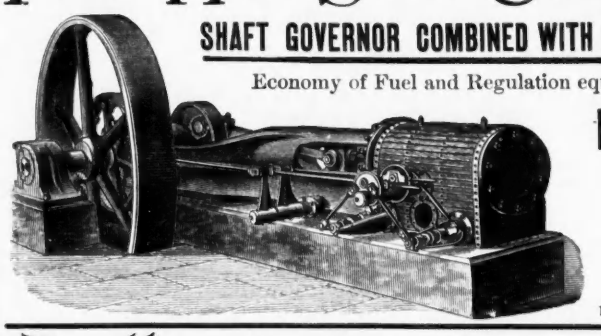
SHAFT GOVERNOR COMBINED WITH CORLISS WRIST-PLATE.

Economy of Fuel and Regulation equal to anything in use.



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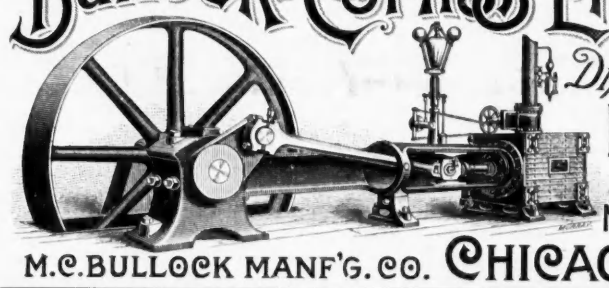

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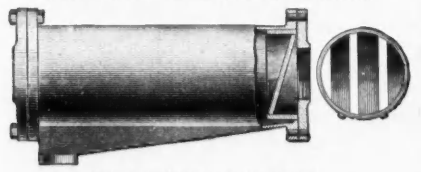

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3/8" FLEXIBLE METALLIC FILLET

For Pattern Makers' Use.

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C. H. DE LAMATER & CO.

have closed their extensive manufactory at the **Foot of West 13th Street, New York**, and have sold the Hot Air Pumping Engine and Steam Pump business to the De Lamater Iron Works (incorporated in 1889), and the Propeller Wheel business to the Samuel L. Moore & Sons Co., of Elizabethport, New Jersey.

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A Very Desirable Lot of Machinery,

such as lathes from 15" to 88" swing, planing machines 48"x45"x10', 53"x50"x12', 17"x14"x24', 72"x69"x24', and various other sizes; drilling machines, slotting machines, shaping machines, boring machines, bolt-cutting machines, cutting-off machines, nut tappers, milling machines, gear cutters, emery tool grinders, portable drills, screw-cutting machines, vises, lathe and planer tools, and a variety of small tools; also traveling and jib cranes.

Punching and shearing machines for boiler makers, with a general outfit of small tools. Blacksmiths' tools, such as anvils, sledges, tongs, etc. Pattern lathes, benches, saws, screws, nails, and a general supply of small tools. Foundry cranes, cupolas and small tools. Blocks, ropes, bolts, nuts, washers, packings, pipe and fittings, iron and brass valves. Boiler iron, steel plate and boiler rivets. Bar iron and steel, also steam hammers, and two 8"x16" and one 10"x20" Rider cut-off engines.

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" "	16 in. x 6 ft.	"	2nd hand A1
" "	16 in. x 6 ft.	Wright,	new
" "	16 in. x 6 ft.	Perkins,	new
" "	16 in. x 8-10 ft.	Hendey	new
" "	18 in. x 8-10 ft.	"	new
" "	18 in. x 8 ft.	Fitchburg,	new
" "	20 in. x 10 ft.	Wright,	new
" "	20 in. x 10 ft.	Pond,	A1 order
" "	21 in. x 8-10 ft.	Fitchburg,	2nd hand, A1
" "	24 in. x 12 ft.	Wright,	new
" "	27 in. x 12 ft.	Lathe & Morse,	new
" "	30 in. x 16 ft.	Wright,	new
" "	60 in. x 20 ft.	Gap Bed,	good order
" "	86 in. x 18 ft.	heavy pattern,	good
Drills, 20 in. wheel feed		Prentice,	new
" 21 in. "	" Back gears,	"	new
" 25 in. Self feed,	Back gears,	"	new
" 32 in. "	"	"	new
Shapers, 14 in. Traveling Head,		Fitchburg,	2nd hand, A1
" 24 in. Friction		Hendey,	2nd hand, A1
" 26 in. Rack,		Lodge, Davis,	new
Planers, 22 in. x 22 in. x 7 ft.		New Haven,	good order
" 24 in. x 24 in. x 6 ft.		Fitchburg,	new
" 24 in. x 24 in. x 6 ft.		Lathe & Morse,	new
" 30 in. x 26 in. x 10 ft.		Putnam,	good order
" 42 in. x 42 in. x 12 ft.		Fitchburg,	2nd hand, A1
" 48 in. x 46 in. x 16 ft.		Heavy pattern,	good order
Screw Machines, No. 1,	Complete,	H. & S.	A1
" " " 3,	"	"	A1
" " " 2,	"	J. & L.	A1
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" " " 20 in.		"	new
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Niles 36 in. Pulley Machine,			A1 order
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The No. 2 Surface Grinding Machine is not very well known. We have rather neglected it in our advertising and have not very generally introduced it. It deserves to be well known. It is useful for grinding dies, punches, and all small parts of machinery, and produces a true surface and a high finish.

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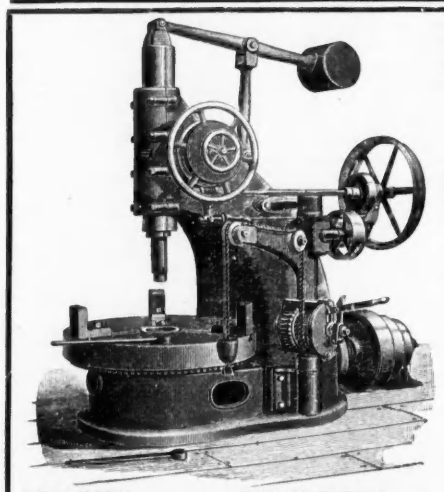

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Nothing but best Steam Metal used in the manufacture.
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None are genuine unless stamped with "Trade Mark."
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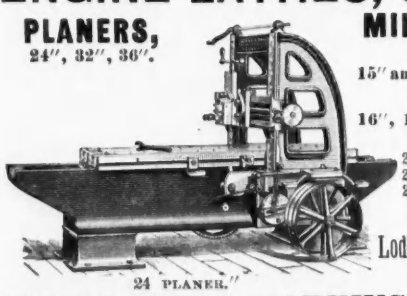
24", 32", 36".



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20 in. Upright Drills. 25 in. Back Geared, and
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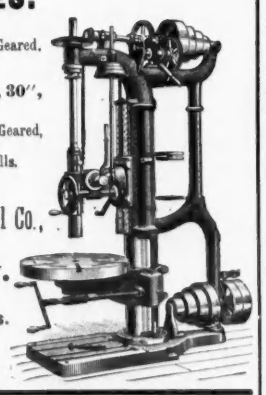

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More **economical** than any we have ever used.
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Best in the market. Much admired.
No trouble or expense for repairs.
Could not ask for anything better.
There may be as good a one made by some one else, but **I have not seen it.**
I feel that **I did wisely** in buying your tool.
We consider it a **model tool** and fills the whole bill.

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Daft Electric Light Co., Marion, N. J.	3
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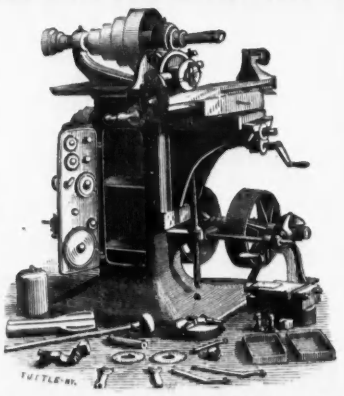

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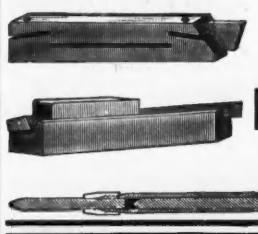

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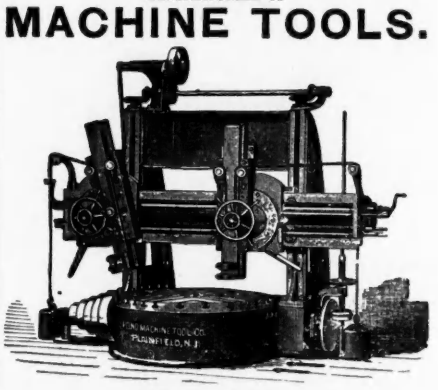

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Radial Drills, Planers, Lathes, Heavy & Powerful, from new patterns of the latest and best designs.
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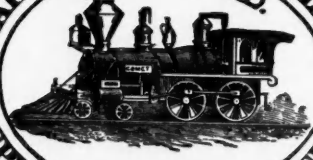

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Positive. Handy. Simple.
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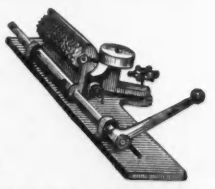

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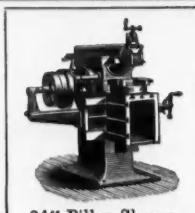

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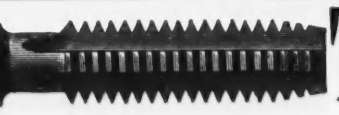

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